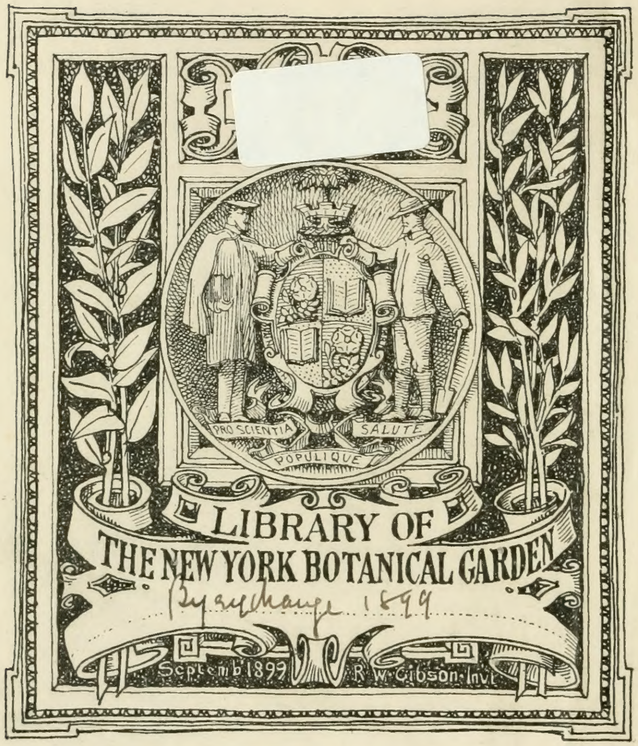
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THIRTY-SEVENTH ANNUAL REPORT
OF THE
SECRETARY
OF THE
STATE BOARD OF AGRICULTURE
OF THE
STATE OF MICHIGAN
AND
ELEVENTH ANNUAL REPORT
OF THE
AGRICULTURAL COLLEGE EXPERIMENT STATION
FROM
JULY 1, 1897, TO JUNE 30, 1898

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REPORT OF THE SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

AGRICULTURAL COLLEGE,
July 1, 1898.

TO HON. HAZEN S. PINGREE,
Governor of the State of Michigan:

SIR—I have the honor to submit to you herewith, as required by statute, the accompanying report for the fiscal year ending June 30, 1898, with supplementary papers.

Very respectfully,
IRA H. BUTTERFIELD,
Secretary of the State Board of Agriculture.

STATE BOARD OF AGRICULTURE.

	Term expires.
FRANKLIN WELLS, Constantine,	1901
President of the Board.	
CHAS. W. GARFIELD, Grand Rapids,	1899
CHARLES F. MOORE. St. Clair,	1899
CHAS. J. MONROE, South Haven,	1901
ARTHUR C. BIRD, Highland,	1903
THOS. F. MARSTON, Bay City,	1903
HAZEN S. PINGREE, Governor of the State,	*Ex officio.*
JONATHAN L. SNYDER, Ph. D., Pres. of the College,	

IRA H. BUTTERFIELD, Agricultural College, Secretary.
BENJAMIN F. DAVIS, Lansing, Treasurer.

STANDING COMMITTEES.

The President of the Board is *ex officio* a member of each of the Standing Committees:

Finance,	C. W. Garfield, A. C. Bird.
Farm Management,	C. J. Monroe, C. F. Moore.
Botany and Horticulture,	C. W. Garfield, C. J. Monroe.
Buildings and Property,	T F. Marston, A. C. Bird.
Employees,	C. J. Monroe, C. F. Moore, J. L. Snyder.
Farmers' Institutes,	C. J. Monroe, C. W. Garfield.
Mechanics,	C. F. Moore, T. F. Marston.
Veterinary Dep't,	A. C. Bird, T. F. Marston.
College Land Grant,	A. C. Bird, C. W. Garfield.
Military Dep't,	T. F. Marston, C. F. Moore.
State Weather Service,	C. J. Monroe, T. F. Marston.
Experiment Station,	Chas. W. Garfield, C. F. Moore.
Library,	A. C. Bird, C. W. Garfield.

STATE AGRICULTURAL COLLEGE.

(Under Control of the State Board of Agriculture.)

FACULTY AND OTHER OFFICERS.

Jonathan L. Snyder, Ph. D., President; [a,b,c] Feb. 20, '96.

Robert C. Kedzie, M. A., M. D., Professor of Chemistry and Curator of the Chemical Laboratory; [a,b,c] Feb. 25, '63.

Wm. J. Beal, M. A., Ph. D., Professor of Botany and Forestry and Curator of the Botanical Museum; [a,b] July 9, '70; [c] Feb. 22, '71.

*E. A. A. Grange, V. S., Professor of Veterinary Science; [a,b,c] May 22, '83.

Levi R. Taft, M. S., Professor of Horticulture and Landscape Gardening, and Superintendent of the Horticultural Department, [a,b,c] Aug. 1, '88.

Howard Edwards, M. A., LL. D., Professor of English Literature and Modern Languages; [a,b,c] Aug. 25, '90.

Herman K. Vedder, C. E., Professor of Mathematics and Civil Engineering; [a,b,c] Sept. 15, '91.

Ira H. Butterfield, Secretary; [a,b,c] July 1, '93.

Clinton D. Smith, M. S., Professor of Practical Agriculture and Superintendent of the Farm; [a,b,c] Sept. 1, '93.

Chas. L. Weil, S. B., Professor of Mechanical Engineering and Director of the Mechanical Department; [a,b,c] Sept. 1, '93.

Walter B. Barrows, S. B., Professor of Zoology and Physiology, and Curator of the General Museum; [a,b,c] Feb. 15, '94.

Harry H. Bandholtz, First Lieutenant Seventh Infantry, Professor of Military Science and Tactics; [a,b,c] Aug. 15, '96.

Edith F. McDermott, Professor of Domestic Economy and Household Science; [a,b,c] Sept. 1, '96.

Frank S. Kedzie, M. S., Adjunct Professor of Chemistry; [a,b] Sept. 15, '80; [c] Jan. 1, '91.

Philip B. Woodworth, B. S., M. E., Assistant Professor of Physics; [a,b] May 22, '87; [c] Aug. 7, '89.

William S. Holdsworth, B. S., Assistant Professor of Drawing; [a] Feb. 22, '81; [b] Aug. 22, '87; [c] Jan. 1, '90.

Alvin B. Noble, Ph. B., Assistant Professor of English Literature and Modern Languages; [a,b,c] Sept. 1, '89.

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*Resigned August 1, '97.

Wilbur O. Hedrick, B. S., Assistant Professor of History and Political Economy; [a,b] Aug. 24, '91; [c] Sept. 1, '93.

Warren Babcock, Jr., B. S., Assistant Professor of Mathematics; [a,b] June 30, '91; [c] Sept. 1, '93.

Charles F. Wheeler, B. S., Assistant Professor of Botany; [a,b] Mar. 1, '90: [c] June 1, '93.

Herbert W. Mumford, B. S., Assistant Professor of Animal Husbandry; [a] Sept. 1.

Mrs. Linda E. Landon, Librarian; [a,b,c] Aug. 24, '91.

A. L. Westcott, B. M. E., Instructor in Mechanical Engineering; [a,b,c] June 1, '93.

Dick J. Crosby, B. S., Instructor in English; [a,b,c] Sept. 1, '93.

Burton O. Longyear, Instructor in Botany; [a,b,c] Feb. 15, '94.

Gordon H. True, B. S., Instructor in Dairying; [a,b,c] Sept. 1, '94.

Merrit W. Fulton, B. S., Instructor in Agriculture; [a,b,c] Sept. '95.

Harry E. Smith, B. S., Instructor in Mechanics; [a,b,c] Sept. 1, '96.

Rufus H. Pettit, B. S. A., Instructor in Zoology; [a,b,c] Sept. 1, '97.

Mrs. Maud A. Marshall, Instructor in Music; [a,b,c] Sept. 1, 97.

Mrs. Jennie L. K Haner, Instructor in Sewing; [a,b,c] Sept. 1, '97.

William O. Beal, B. S., Instructor in Mathematics; [a,b,c] Sept. 1, '97.

Kenyon L. Butterfield, Supt. Institutes; [a,b,c] June 1, '95.

† Lillian Wheeler, Assistant Instructor in Mathematics.

† Mrs. Ella M. Kedzie, Assistant Instructor in Drawing.

Thomas Gunson, Foreman of Greenhouse; [a,b] April 1, '91; [c] Sept. 1, '91.

|| Thomas Durkin, Foreman of the Horticultural Department; [a,b,c] March 15, '94.

W. S. Leonard, Foreman of the Iron Shop; [a,b,c] Sept., '97.

‡ Ernest Wittstock, Foreman of the Farm; [a,b,c] Feb. 2, '93.

Charles H. Alvord, B. S., Foreman of the Farm; [a,b,c] April 1, '98.

¶ C. E. Hoyt, Foreman of the Wood Shop; [a,b,c] Feb. 18, '95.

W. R. Bradford, Foreman of the Wood Shop; [a,b,c] Jan'y 1, '98.

Chace Newman, Clerk in Mechanical Department; [a,b,c] Dec. 1, '92.

E. C. Baker, Foreman of the Foundry; [a,b,c] Jan'y 1, '98.

Fred C. Kenney, Assistant Secretary; [a,b,c] Sept. 18, '95.

Fremont E. Skeels, Assistant Secretary; [a,b,c] Oct. 1, '97.

Fred C. Kenney, Cashier; [b,c] Oct. 1, '97.

Edwin S. Good, Clerk to the President; [a,b,c] July 15, :96.

Mrs. Harriet G. Bacon, Matron Women's Dormitory.

Pliny M. Lyman, Clerk Secretary's Office; [a,b,c] Oct. 1, '97.

§ D. B. Baldwin, Engineer, [a,b,c] June 1, '96.

F. L. Newell, Engineer; [a,b,c] Jan'y 1, '98.

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a First appointment.
b Present appointment.
c Present title.
d Resignation.
† Temporary appointments.

‡ Resigned April 1, c '98.
|| Resigned May 1, c '98.
¶ Resigned January 1, '98.
§ Resigned October 15, '97.

AGRICULTURAL EXPERIMENT STATION.

OF THE

STATE AGRICULTURAL COLLEGE.

[Under control of the State Board of Agriculture.]

STATION COUNCIL.

Clinton D. Smith, M. S.,	Director.	Robt. C. Kedzie, M. A., M. D.,	Chemist.
J. D. Towar, B. S.,	Agriculturist.	Ira H. Butterfield,	Sec. and Treas.
L. R. Taft, M. S.,	Horticulturist.	J. L. Snyder, Pres.,	*Ex officio* member.

ADVISORY AND ASSISTANT STAFF.

Herbert W. Mumford, B. S.,	Assist't in Live Stock.	R. H. Pettit, B. S. A.,	Assistant Entomologist.
H. P. Gladden, B. S.,	Assistant in Horticulture.	Chas. F. Wheeler, B. S.,	Consulting Botanist.
M. L. Dean,	" " "	Mrs. L. E. Landon,	Librarian.
L. S. Munson, B. S.,	Assistant in Chemistry.	T. T. Lyon, So. Haven,	In charge of Sub-Station.
G. A. Waterman, V. S.,	Consulting Veterinarian.	C. E. Marshall, Ph. B.,	Assistant Bacteriologist.
W. B. Barrows, S. B.,	Consulting Entomologist.	C. S. Brooks,	Foreman Poultry Department.

STANDING COMMITTEE OF THE BOARD.

G. W. Garfield. C. F. Moore.

SUB-STATIONS.

Grayling, Crawford county, 80 acres deeded.

South Haven, Van Buren county, 10 acres rented ; 5 acres deeded ; Local Agent, T. T. Lyon, President State Horticultural Society.

STATE WEATHER SERVICE.

[Under control of the State Board of Agriculture.]

OFFICERS OF THE SERVICE.

Director, - - - - - - C. F. Schneider, U. S. Weather Service, Lansing.

STANDING COMMITTEE IN CHARGE.

Hon. C. J. Monroe,	South Haven.
Hon. Chas. W. Garfield,	Grand Rapids.

ACCOUNTS OF THE STATE AGRICULTURAL COLLEGE.

FOR THE FISCAL YEAR ENDING JUNE 30, 1898.

SECRETARY'S ACCOUNT.

			Dr.	Cr.
July 1, 1897.	To cash on hand		$5,320 28	
	To cash on deposit with treasurer		2,765 08	
	By cash on deposit with New York bank, overdraft			$36 77
	By balance due students on deposit			1,384 45
June 30, 1898.	To special appropriation receipts			
	From State Treasurer	$19,200 00		
	From United States Treasurer	15,000 00		
	From institution	1,781 14		
			35,981 14	
	By special appropriation disbursements			42,455 77
	To current account receipts			
	From State Treasurer	$55,000 00		
	From United States Treasurer	23,000 00		
	From institution	12,909 77		
	From building fund	5,919 07		
			96,828 84	
	By current account disbursements			
	General current	$84,343 08		
	Building fund	8,182 01		
				92,525 09
	To balance due students		1,267 68	
	By cash on deposit with college treasurer			3,574 39
	By cash on deposit New York bank			441 14
	By cash on hand			1,745 41
			$142,163 02	$142,163 02

TABLE No. 1.—*Tabular exhibit of Secretary's account.*

Name of account.	Balance sheet July 1, 1897.		Transactions July 1, 1897 to June 30, 1897.		Balance sheet June 30, 1898.	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
Cash	$5,283 51			$3,096 96	$2,186 55	
*College treasurer	2,765 08		$809 31		3,574 39	
Student's deposits		$1,384 45	116 77			$1,267 68
Special appropriations		6,798 81	42,455 77	35,981 14		324 18
General current	5,587 54		84,343 08	90,909 77		979 15
Current building		5,452 87	8,182 01	5,919 07		3,189 93
Totals	$13,636 13	$13,636 13	$135,906 94	$135,906 94	$5,760 94	$5,760 94

*Treasurer's statement is greater July 1, 1897, by $2,846.95, and June 30, 1898, by $3,349.98, warrants outstanding.

TREASURER'S ACCOUNT.

	Dr.	Cr.
Balance July 1, 1897	$5,612 03	
Receipts from State Treasurer and Secretary of State Board of Agriculture	134,469 30	
Interest on deposits, 11 months at 3 per cent	315 79	
Warrants paid from July 1, 1897, to June 30, 1898		$133,472 85
Balance on hand June 30, 1898		6,924 27
	$140,397 12	$140,397 12

TABLE NO. 2.—*Statement of special appropriation account for fiscal year July 1, 1897, to June 30, 1898.*

Name of appropriation.	Balance of account July 1, 1897.		Receipts during fiscal year.		Total available.	Total expended.	Balance of account June 30, 1898.		Balance of appropriation in State Treasury June 30, 1898.
	Dr.	Cr.	From State Treasury.	From Institution.			Dr.	Cr.	
Experiment station		$2,779 12	*$15,000 00	$1,661 66	$19,440 78	$17,740 26		$1,700 52	$250 00
Weather service	$13 75		1,00 00	12 30	998 55	925 76		72 79	
Repairs		3,033 44	6,000 00	82 12	9,115 56	9,735 82	$620 26		3,000 00
Institutes			5,500 00	25 00	5,525 00	5,525 00			5,500 00
Student labor		1,000 00	1,500 00		2,500 00	3,328 87	828 87		2,500 00
Bath room			200 00	06	200 06	200 06			
Electric light plant			5,000 00		5,000 00	5,000 00			
Balance	6,798 81						324 18		
Total	$6,812 56	$6,812 56	$34,200 00	$1,781 14	$42,779 95	$42,455 77	$1,773 31	$1,773 31	$11,250 00

* Received direct from U. S. Treasury and expenditure accounted for to Auditor General.

TABLE No. 3.—*Current account July 1, 1895, to June 30, 1896.*

On account of—	Dr. To disbursements.	Cr. By receipts.
United States Treasurer, sixth annual payment under act of congress of August 30, 1890		$23,000 00
State Treasurer, interest on proceeds of sales of U. S. land grant, see table No. 13		55,000 00
Students' class fees, per table No. 8		3,583 91
Students' sundry fees, credited to building account, per table No. 8		5,580 48
Salaries paid	$42,426 77	
Farm department, see table No. 5, page 13	8,686 84	5,015 79
Horticultural department, see table No. 6, page 13	4,131 38	912 26
Mechanical department	3,009 38	
Heating, lighting and cleaning	11,965 86	
Academic departments	6,124 07	
Office, postage, stationery, advertising, etc.	4,118 87	
Miscellaneous sundry	3,879 91	
State swamp land grant sale, credited to building account		
Sundry receipts credited to building account		
Interest and exchange, credited to building account		338 59
Building account	8,182 01	
Miscellaneous receipts		3,397 81
Totals	$92,525 09	$96,828 84
Balance at beginning of period, July 1, 1897	134 67	
Balance at close of period, June 30, 1898	4,169 08	
Footings	$96,828 84	$96,828 84

TABLE No. 4.—*Experiment Station account July 1, 1895, to June 30, 1896.*

On account of—	Dr. To Disbursements.	Cr. By receipts.
Balance from last fiscal year		$2,779 12
United States Treasurer for fiscal year		15,000 00
Fertilizer, license fees and expenses		1,380 00
Salaries paid	$8,298 77	
Farm department	2,537 23	267 04
Horticultural department	587 08	
Chemical department	383 05	
Botanical department	141 70	
Zoological department	13 92	
Veterinary department	1,079 81	
Buildings	1,452 39	
Library	220 84	
Sundry	140 41	14 62
Offices, etc.	655 18	
South Haven station	1,989 21	
Apiary	240 67	
Balance on hand at close of fiscal year	1,700 52	
Totals	$19,440 78	$19,440 78

TABLE NO. 5.—*Employees and salaries.*

OFFICER.	Rate per year.	Classification.		Other Sources.	
		Current.	Experim't Station.		
President	$3,200 00	$3,200 00			and dwelling.
Professor chemistry	2,000 00	1,700 00	$300 00		" "
" botany	1,800 00	1,800 00			" "
" agriculture	2,300 00	1,200 00	1,100 00		" "
" horticulture	1,800 00	1,200 00	600 00		" "
" mathematics	1,800 00	1,800 00			" "
" mechanical engineering	1,800 00	1,800 00			" "
" zoology	1,800 00	1,800 00			" "
" veterinary science	1,500 00	1,200 00	300 00		
" English	1,800 00	1,800 00			and house.
Adjunct professor chemistry	1,800 00	1,800 00			
Assistant professor physics	1,200 00	1,200 00			and rooms.
" " drawing	1,200 00	1,200 00			" "
Secretary	1,800 00	300 00	500 00	$1,000 00	and dwelling.
Assistant secretary	1,200 00	1,200 00			
Librarian	725 00	605 00	120 00		and rooms.
Assistant professor English	1,000 00	1,000 00			" "
" " mathematics	1,000 00	1,000 00			" "
" " history and political economy	900 00	900 00			" room.
Assistant professor botany	1,000 00	500 00	500 00		" "
" " animal husbandry	1,500 00	1,500 00	500 00		" "
" " bacteriology	1,000 00		1,000 00		
Matron	300 00	300 00			and room.
Professor domestic science	1,000 00	1,000 00			" "
Instructor in sewing	500 00	500 00			" "
" " music	500 00	500 00			
" " mechanical engineering	800 00	800 00			and rooms.
" " English	500 00	500 00			" room.
" " botany	500 00	500 00			" "
" " mathematics	500 00	500 00			" "
" " dairying	600 00	600 00			" "
" " agriculture	500 00	500 00			" "
" " mechanics	600 00	600 00			
" " zoology	1,000 00	500 00	500 00		and house.
" " mechanical drawing	420 00	420 00			" room.
College field agent	600 00	600 00			
Cashier	700 00	700 00			and room.
Engineer	600 00			Heating. 600 00	" rooms.
Florist	800 00	800 00			" house.
Foreman farm	600 00	600 00			" "
" horticultural department	500 00	500 00			" room.
" wood shop	600 00	600 00			
" machine shop	750 00	750 00			
" foundry	468 00	468 00			
Clerk in P. O.	500 00	500 00			and room.
" president	500 00	500 00			" "
" mechanical department	420 20			Mechan'l. 420 00	
" to secretary	360 00	360 00			
Herdsman	420 00	420 00			and board.
Assistant greenhouse	420 00			Hort. dept. 420 00	
Agriculturist	1,000 00		1,000 00		and room.
Assistant in Horticulture	800 00		800 00		
" " "	700 00		700 00		and rooms.
" " chemistry	500 00		500 00		" "
Professor military science	1,800 00	Pd by U. S			" "
Totals	$54,473 00	$43,613 00	$8,420 00	$2,440 00	

TABLE NO. 6.—*Account with Farm Department.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Labor, aside from student labor	$2,000 27	
Farm house	8 01	
Cattle	2,281 11	$390 83
Sheep	412 03	622 41
Swine	242 31	602 13
Grain		278 82
Implements and repairs	557 68	
Wood		84 83
Office and sundry	230 25	949 04
Drains	18 09	
Seeds	73 30	
Board of farm hands	682 40	
Team	231 20	
Dairy	1,638 30	2,048 26
Fence	101 67	
Produce		39 47
Freight	204 22	
Balance		3,671 05
Footings	$8,686 84	$8,686 84

TABLE NO. 7.—*Account with Horticultural Department, including greenhouse.*

On account of—	Dr. To disbursements.	Cr. By receipts.
Labor, aside from student labor	$2,490 83	
Team	411 88	
Grounds and vaults	136 00	
Freight	46 92	
Implements and repairs, tools	72 85	
Seeds and plants and fertilizers	114 81	
Sundry	294 30	
Ice	9 00	
Office	38 20	
Sundry receipts and garden products sold		$912 26
Greenhouse labor and plants	516 59	
Balance		3,213 12
Footings	$4,125 38	$4,125 38

TABLE NO. 8.—*Students' fees.*

On account of—	Current account, general.	Current account, building.	Total.
Room rent		$4,013 25	$4,013 35
Incidental expense fees	$2,817 50		2,817 50
Physiological dissection fees	1 50		1 50
Veterinary dissection fees			
Chemical analysis fees	448 00		448 00
Damages		15 13	15 13
Special examination fees		47 00	47 00
Matriculation fees		1,225 00	1,225 00
Diploma fees		140 00	140 00
Tuition fees from non-resident students			
Physical fees	20 00		20 00
Music	184 91		184 91
Cooking and sewing	112 00		112 00
Totals	$3,583 91	$5,580 48	$9,164 39

TABLE NO. 9.—*Students' labor.—Account of wages paid for twelve months, July 1, 1895, to June 30, 1896.*

On account of—	Total.
Farm department	$1,202 39
Horticultural department	602 65
Mechanical department, repairs and heating	
Bell ringing, choir, etc.	37 00
Janitor	604 83
Offices	90 19
Veterinary department	17 08
Zoological department	18 68
Botanical department	31 14
Physical department	6 44
Engineering department	
Military department	58 00
M. A. C. Record	22 23
Chemical department	19 00
Lightning	
Experiment station	47 33
Total	$2,756 96

TABLE NO. 10.—*Agricultural College lands, United States grant of 1862; record of sales and forfeitures to the present time.*

Year.	Original sales.					Forfeited lands resold.					Total sales.				
	Acres.	Aver'ge price per acre.	Amount sold for.	Amount paid.	Amount unpaid.	Acres.	Aver'ge price per acre.	Amount sold for.	Amount paid.	Amount unpaid.	Acres.	Aver'ge price per acre.	Amount sold for	Total amount paid.	Total amount unpaid.
1867															
1868	520	$5 00	$2,600 00								520	$5 00	$2,600 00		
1869	13,480	3 19	43,000 00								13,480	3 19	43,000 00		
1870	3,280	3 44	11,280 00								3,280	3 44	11,280 00		
1871	9,372.44	3 37	31,637 32								9,372.44	3 37	31,637 32		
1872	20,580.25	3 19	65,660 75								20,520.25	3 19	65,660 75		
1873	17,205.89	3 15	54,177 67			40	$3 62	$145 00			17,245.89	3 15	54,322 67		
1874	2,039.95	3 20	6,519 75			40	3 00	120 00			2,079.92	3 19	6,639 75		
1875	4,798.99	3 08	14,796 97			40	3 00	120 00			4,838.99	3 08	14,916 97		
1876	1,953.73	3 12	6,101 19			520	4 38	2,280 00			2,473.73	3 39	8,381 19		
1877	1,634.75	3 00	4,904 25			200	3 00	600 00			1,834.75	3 00	5,504 25		
1878	4,034.80	3 10	12,504 40			1,135.73	3 91	4,443 65			5,170.53	3 28	16,948 05		
1879	6,782.12	3 02	20,506 36			1,318.06	3 08	4,054 18			8,100.18	3 03	24,560 54		
1880	8,826.56	3 03	26,729 58			280	3 18	890 00			9,106.56	3 03	27,619 58		
1881	6,168.97	3 96	24,447 25			360	4 33	1,560 00			6,528.97	3 98	26,007 25		
1882	10,225.99	5 00	51,129 95			1,637.01	5 09	8,335 05			11,863	5 01	59,465 00		
1883	7,035.57	5 00	35,177 85			1,680	5 03	8,448 00			8,715.57	5 00	43,625 85		
1884	1,846.01	5 09	9,390 05			526.45	5 38	2,832 25			2,372.46	5 15	12,222 30		
1885	704.88	5 74	4,044 40			119.52	5 67	677 60			824.40	5 73	4,722 00		
1886	720	5 83	4,200 00			560	5 78	3,240 00			1,280	5 81	7,440 00		
1887	1,718.27	6 45	11,091 35			320	5 00	1,600 00			2,038.27	6 23	12,691 35		
1888	2,031.18	6 02	12,235 90			160	5 00	800 00			2,191.16	5 95	13,035 90		
1889	1,000.28	6 64	6,641 40			40	5 00	200 00			1,040.28	6 58	6,841 40		
1890	2,674.70	8 06	21,561 88								2,674.70	8 06	21,561 88		
1891	2,614.66	8 26	21,593 02			480	6 47	3,105 00			3,094.66	7 98	24,698 02		
1892															
1893	13,376.04	7 47	100,960 99			1,605.95	8 53	10,494 75			14,981.99	7 44	111,455 74		
1894	40	12 50	500 00								40	12 50	500 00		
1895	43.35	5 38	233 50								43.35	5 38	233 35		
1896	1,498.10	8 10+	12,136 69			440.11	7 91+	3,495 55			1,938.21	8 06	15,632 24		
1897	2,556.63	7 35	18,791 28			239.47	7 66	1,836 29			2,796.00	7 38+	20,627 57		
1898	9,285.17	7 54—	70,000 72	$45,436 96	$24,563 76	639.55	7 46+	4,771 45	$3,751 55	$1,020 00	9,924.72	7 60+	75,772 27	$50,188 51	$25,583 76
Total	158,038.28	$4 39+	$694,554 47	$45,436 96	$24,563 76	12,381.85	$5 17	$64,058 87			170,431.03	$4 51+	$769,703 19		

TABLE NO. 11.—*Agricultural College lands, United States grant of 1862; record of forfeitures by counties during the fiscal year ending June 30, 1898, and of the number of acres vacant at the beginning and end of the year.*

Counties.	Acres vacant June 30, 1897, as reported by the land office.	Acres reverting by forfeiture during the fiscal year ending June 30, 1898	Sales during 1898.	Acres vacant June 30, 1898, if columns 1, 2, and 3 are correct.	Acres vacant June 30, 1898, as reported by the land office.	Discrepancy between columns 4 and 5.		Net discrepancy noted on page 15, report 1895, Reprint of table No. 11 of 1894.		Total net discrepancy from reports of land office prior to 1889.	
						Shortage.	Excess.	Shortage.	Excess.	Shortage.	Excess.
Alcona	18,525.71			18,525.71	18,685.71		160.00	80.		80.	
Alpena	920.00			920.00	920.00			40.		80.	
Antrim	2,441.97		1,281.97	1,160.00	760.00	400.00		40.			
Benzie	2,760.00		440.00	2,320.00	2,320.00						
Charlevoix	2,159.43		* 2,281.42		198.01		198.01	10.			
Cheboygan	5,239.81	120.00	400.00	4,959.81	4,845.96	113.85			34.86		28.71
Grand Traverse	160.00			160.00	160.00						
Iosco	26,322.27			26,322.27	26,282.27	40.00					
Kalkaska	1,118.00		280.00	838.00	878.00		40.00	60.		280.	
Manistee	4,505.86		1,556.84	2,949.02	3,030.08		81.06	39.98½		00.50	
Missaukee	879.64		199.64	680.00	640.00	40.00					
Montmorency	6,404.95		84.85	6,320.10	6,320.00	00.10		80.		40.	
Oscoda	13,370.22			13,370.22	13,250.22	120.00			83.38		83.28
Otsego	916.58		40.00	876.58	837.56	39.02					
Presque Isle	400.00			400.00	426.46		26.46		80.		80.
Wexford	11,992.01		3,360.00	8,632.01	8,591.81	40.20		220.		39.80	
Totals	98,116.45	120.00	9,924.72	88,433.72	88,146.08	792.17	505.53	709.985	198.14	328.31	

* 122.01 acres in Charlevoix county forfeited in 1897 and omitted from table of that year.

TABLE NO. 12.—*Land Grant 1862; aggregate of sales and forfeitures to 1898.*

Year.	Number of acres reverting by forfeitures.	Aggregate of sales, less forfeitures to end of each year. Acres.	Balance remaining vacant at end of each year. Acres.
1867			235,682.46
1868		520.	235,162.46
1869		14,000.	221,682.46
1870		17,280.	218,402.46
1871		26,652.44	209,030.02
1872		47,232.69	188,449.77
1873	40.	64,438.58	171,243.88
1874	638.72	65,879.81	169,802.65
1875	560.	70,158.80	165,523.66
1876	1,758.40	70,874.13	164,808.33
1877	1,438.06	71,270.82	164,411.64
1878	2,415.73	74,025.62	161,656.84
1879	1,978.11	80,147.69	155,534.77
1880	4,926.33	84,327.92	151,354.54
1881	1,987.19	88,869.70	146,812.76
1882	760.11	99,972.59	135,709.87
1883	560.	108,128.16	127,554.30
1884	200.	110,300.62	125,381 84
1885	525.47	110,599.55	125,082.91
1886	440.	111,439.55	124,242.91
1887	200.	113,277.82	122,404.64
1888	640.	114,829.	120,853.46
1889	120.	115,749.28	* 119,585.86
1890	480.	117,943.98	117,391.16
1891	920.	120,118.64	115,216.50
1892	480.	119,638.64	† 115,996.55⅙
1893	360.	134,260.63	‡ 100,909.98½
1894	440.	133,860.63	§ 101,494.01½
1895	200.	133,703.98	101,650.665
1896	160.	135,482.19	99,872.455
1897	1,040.00	137,238.19	98,116.45
1898	120.00	147,012.91	¶ 88,311.73
Total	23,388.12		

* This amount is 347.32 less than it should be; as to which see p. 19 of report for 1889.
† This amount is 300.055 more than accords with the report of 1891; as to which see page 15 of 1892.
‡ This amount is 464.58 less than accords with the report of 1892; as to which see p. 16 of 1895.
§ This amount is 204.03 more than accords with the report of 1893; as to which see p. 16 of 1895.
¶ This amount is 327.79 less than it should be to correspond with original amount.

TABLE NO. 13.—*Agricultural College trust fund.*

Year.	Receipts of State land office on account of principal for Agricultural College lands sold.	Refunded on account of erroneous payments.	Balance transferred to credit of Agricultural College trust funds.	Aggregate to credit of Agricultural College trust fund at close of each fiscal year.
1868	$2,300 00		$2,300 00	$2,300 00
1869	11,865 00		11,865 00	14,165 00
1870	5,895 00		5,895 00	20,060 00
1871	20,101 53		20,101 53	40,161 53
1872	33,621 93	$174 54	33,447 39	73,608 92
1873	29,583 47		29,583 47	103,109 39
1874	4,686 75		4,686 75	107,879 14
1875	5,399 24		5,399 24	113,278 38
1876	5,939 30	390 00	5,549 30	118,827 68
1877	2,337 22		3,337 22	121,164 90
1878	9,619 99		9,619 99	130,784 89
1879	8,590 53		8,590 53	139,375 42
1880	13,762 28		13,762 28	153,137 70
1881	20,341 18	60 00	20,281 18	173,418 88
1882	51,449 27		51,449 27	224,868 15
1883	34,482 28	825 90	33,656 38	258,524 53
1884	13,802 87		13,802 87	272,327 40
1885	12,460 87		12,460 87	284,788 27
1886	16,545 31		16,545 31	301,333 58
1887	26,731 62		26,731 62	328,065 20
1888	18,122 35		18,122 35	346,187 55
1889	11,431 65		11,431 65	357,619 20
1890	15,991 64		15,991 64	373,610 84
1891	21,994 89		21,992 89	395,605 73
1892	5,808 90	180 00	5,628 90	401,234 63
1893	120,468 27		120,468 27	521,702 90
1894	4,235 08		4,235 08	525,937 98
1895	4,626 63		4,626 63	530,564 61
1896	16,714 49		16,714 49	547,279 10
1897	22,672 72		22,672 72	569,951 10
1898	55,839 16		55,839 16	625,780 26

NOTE.—Fifteen thousand dollars of the above fund was invested from 1870 to 1871 in war bounty bonds and held by the College.

TABLE NO. 14.—*Agricultural College interest fund.*

Year.	Interest on Agricultural College fund at 7 per cent. paid by State Treasurer from specific tax fund.	Interest from purchasers on balances due on certificates for part-paid land less refundings and expenses for appraisals, etc. †	Receipts for penalty.	Trespass collections.	Total accrued to credit of Agricultural College each year.	Amount paid over to treasurer of Agricultural College.	Balance remaining to credit of Agricultural College interest fund at close of each fiscal year.
1869	----------	$56 68	$2 28	----------	$58 96	----------	$58 96
1870	*$874 95	1,789 56	56 42	----------	2,720 93	$2,779 89	----------
1871	§ 1,397 97	2,317 24	70 63	----------	3,785 84	2,976 00	809 84
1872	3,953 17	3,099 51	122 97	----------	7,175 65	6,774 47	1,211 02
1873	6,040 33	4,907 77	110 96	----------	11,059 06	12,238 48	31 60
1874	7,407 65	6,499 21	155 12	----------	14,061 98	11,896 00	2,197 58
1875	7,717 24	6,552 93	125 97	$50 00	14,446 14	14,656 00	1,987 72
1876	8,124 31	6,692 47	306 64	1,703 75	16,830 17	18,817 89	----------
1877	8,396 64	5,726 58	189 61	860 00	15,172 86	15,172 86	----------
1878	8,740 62	6,405 26	247 21	414 00	15,807 09	13,320 61	2,486 48
1879	9,409 73	6,664 80	276 55	627 14	16,978 22	16,602 02	2,862 68
1880	10,240 28	7,333 23	148 73	115 00	17,837 24	17,799 15	2,900 77
1881	11,426 93	8,642 08	285 47	580 77	20,935 25	20,451 85	3,384 17
1882	13,957 04	8,345 45	204 96	----------	22,507 45	25,891 62	----------
1883	16,741 38	9,141 30	206 96	4,659 96	30,749 60	26,139 13	4,610 47
1884	18,739 02	8,881 98	237 56	51 16	27,909 72	27,402 94	5,117 25
1885	19,645 33	9,121 14	329 06	674 87	29,770 40	29,599 97	5,287 68
1886	20,571 65	9,323 98	565 41	----------	30,461 04	29,920 68	5,828 04
1887‡	16,493 98	7,577 57	309 84	229 98	24,611 37	19,761 04	10,678 35
1888	23,425 64	7,310 84	394 85	1,275 27	32,406 60	32,006 10	11,078 85
1889	24,551 32	6,326 39	320 23	124 75	31,322 69	31,888 12	10,513 42
1890	25,653 31	6,490 27	387 25	20 00	32,360 64	32,228 79	10,645 27
1891	27,197 89	6,690 99	348 22	513 44	34,750 54	26,516 92	18,878 89
1892	27,892 14	6,639 20	316 78	100 00	34,948 12	26,153 78	27,673 23
1893	31,464 01	6,107 32	315 71	40 00	37,927 04	51,600 34	13,999 93
1894	36,657 47	5,638 31	365 08	1,866 40	44,527 26	34,120 58	24,406 61
1895	36,871 28	5,125 19	305 08	3,139 40	45,440 95	30,000 00	†39,708 46
1896	37,625 50	4,954 60	340 30	966 00	44,037 25	50,000 00	33,594 88
1897	39,009 66	4,817 00	----------	54 09	‡43,779 54	40,000 00	37,374 40
1898	41,234 34	5,293 66	314 92	740 36	‖47,508 28	55,000 00	29,882 68

* This amount was interest on war bounty bonds, in which the fund was invested at the time.

§ $525 of this was interest on war bounty bonds, in which the fund was invested part of the year.

† Appraisal expenses amounted to $1,726.32, ranging from nothing in 1872 to $208.94 in 1886. Advertising amounted to $1,205.20, ranging from nothing in 1870 to $218.35 in 1884 Trespass examination amounted to $4.00 in 1883 Advertising in 1895 amounted to $42.60 and supervisors' appraisals to $96.50, which is deducted to make the balance.

‡ Advertising and appraisals in 1897 amounted to $101.21, which is deducted to make the balance.

‖ Appraisals in 1898 amounted to $75.00, which is deducted to make the balance.

SUMMARY OF INVENTORY, JUNE 30, 1898.

College farm and park, 676 acres @ $70		$47,320 00
Buildings—		
Library and museum, built 1881	$25,000 00	
College hall “ 1856	20,000 00	
Williams “ “ 1869	40,000 00	
Wells “ “ 1877	25,000 00	
Abbott “ “ 1888, add. in 1896	15,000 00	
Chemical laboratory, “ 1871, south end added '81	18,000 00	
Machine shops and foundry, 1885, south end added '87	12,300 00	
Veterinary laboratory, built 1885	5,400 00	
Horticultural “ “ 1888	6,000 00	
Agricultural “ “ 1889, improvements 1897	8,500 00	
Botanical “ “ 1892	10,000 00	
Armory “ 1885	6,000 00	
Greenhouse and stable “ 1873, 1879; rebuilt 1892	6,331 55	
Greenhouse, experiment “ 1889	1,500 00	
Boiler house and chimney 1893–4	5,000 00	
President's and two frame dwellings, built 1874	15,000 00	
Four brick dwellings, built 1857	12,500 00	
Station apartment dwelling, built 1892	3,500 00	
Two brick “ “ 1879 and 1884	7,000 00	
One frame “ “ 1885	4,000 00	
Howard terrace “ “ 1888	14,500 00	
Farm house “ “ 1869	3,500 00	
Herdsman's “ “ 1867	400 00	
Ten barns at professors' houses	2,500 00	
Horticultural barn and shed, built 1868, 1875, 1887	1,500 00	
Cattle barn and shed “ 1862	3,500 00	
Sheep “ “ 1865	2,000 00	
Horse “ “ 1871	2,500 00	
Pig “ “ 1871	2,000 00	
Corn “ “ 1878	500 00	
Grain “ “ 1881	1,600 00	
Horse sheds “ 1894	350 00	
Tool barn built 1881	1,300 00	
Feed “ “ 1884	1,200 00	
Brick work shop, built 1857	600 00	
Observatory “ 1880	150 00	
Bath house and fittings, built 1889	600 00	
Ice house, 1879	200 00	
Bee house, now paint shop, built 1879	150 00	
Bee house, 1884, remodeled dwelling 1893	700 00	
Hospital, 1894	3,500 00	
Poultry building, 1894	575 00	
Poultry yards, 1895	250 00	
Storage barn, 1896	800 00	
Closets in Abbott, Wells and Williams halls	3,000 00	
Side hill forcing house, built 1896	600 00	
Cold storage fruit house “ 1897	1,000 00	
Dairy barn “ 1897	800 00	
Waiting room street car terminus, built 1897	80 00	
Street car track and fixtures, 600 ft. “ 1897	360 00	
Lumber shed, mechanical dept	250 00	
		296,996 55
Iron bridge over Cedar river, built 1888		1,000 00
Water works and steam works—		
Artesian well and connections, sunk in 1887, 343 ft. deep	$1,000 00	
Fire pump, 1883, $650; tank pump, 1881, $200	850 00	
700 feet fire hose, 2½ in., bought 1883–88	300 00	
	$2,150 00	
Forward		$345,316 55

Brought forward		$345,316 55
Water works and steam works—*Continued:*	$2,150 00	
Two hose carts and 4 nozzles, bought 1883–88	99 00	
2,378 ft. wood pipe, 6 in., laid 1883–87	776 00	
2,623 " " " 4 " " 1883–87	640 00	
662 " " " 3 " " 1883–87	155 00	
Water tank and heater, built 1883	518 00	
Thriteen fire hydrants in place, built 1883–87	460 00	
Valves, fittings and connections, laid 1883–87	650 00	
Four boilers, 4 ft. x 12 ft., built 1881	844 00	
Two boilers, 5 ft. x 12 ft., built 1887	1,080 00	
Two small pumps, 1884–91	288 00	
Underground steam piping, laid 1882	1,315 00	
Miscellaneous tools and stock	390 88	
One water purifier	352 00	
Water meter	25 00	
Injector	22 00	
Main steam pipe, 1892	155 00	
Safety valve on water main	10 00	
One pile hammer	10 00	
Six service boxes, in place 1893	8 10	
Six lawn hydrants, in place 1894	16 00	
Five-inch exhaust head	15 00	
Three fire hydrants, 1898	18 00	
1,200 ft. 3 in. iron water main, 1898	160 00	
Steel benching, put in in 1895	265 00	
		10,421 98
Farm Department—		
Cattle, 86 head	$4,297 00	
Sheep, 70 "	720 00	
Horses, 8 "	600 00	
Swine, 23 "	191 00	
Class room, office and farm house equipped	2,343 20	
Tools, implements, scales, windmills, etc.	2,412 16	
Experiment station	1,915 79	
Growing crops, estimated	1,324 48	
Dairy room	974 95	
		14,778 58
Horticultural Department—		
Teams, harness, etc.	$448 00	
Heavy tools	376 80	
Compost and manures	150 00	
Small tools	70 80	
Students' tools	280 01	
Office and other rooms	112 45	
Class room	951 50	
Greenhouse plants	2,492 40	
Vegetable garden	72 00	
Miscellaneous	93 10	
Experiment station	949 75	
Greenhouse tools	265 35	
		6,262 16
Mechanical Department—		
Class room and office equipment	$6,310 11	
Machine shop	7,689 52	
Wood shop	2,407 44	
Blacksmith shop and foundry	1,815 10	
		18,222 17
Chemical Department—		
Furniture, apparatus and chemicals	$11,051 81	
Experiment station	2,018 99	
		13,070 80
Forward		$408,072 24

Brought forward		$408,072 24
Botanical Department—		
Herbarium	$5,227 07	
Museum	900 75	
Office class apparatus and garden tools	2,939 01	
Experiment station	532 99	
		9,599 82
Mathematical and Engineering Department—		
Surveying instruments	$1,987 54	
Telescope and accessories	839 75	
Furniture, apparatus, etc	816 39	
Photographic material	50 55	
Office furniture	279 83	
		3,974 06
Library, exclusive of experiment station library—		
19,862 books and pamphlets	$39,849 00	
Sunday school books	150 00	
Portrait and pictures	848 00	
Furniture	978 60	
Experiment station library	3,661 60	
		45,487 20
Physical Department—Fixtures and apparatus	$7,230 89	
Veterinary laboratory—Museum furniture and apparatus	3,479 82	
Zoological Department—Furniture and apparatus	2,258 50	
General Museum—Collections and cases	17,337 50	
College hall furniture and English department	985 50	
Drawing	972 15	
Public parlor furniture, $50.80, hospital furniture, $29.20	80 00	
Club boarding association, 15 shares stock	300 00	
President's office	583 45	
Secretary's office	1,875 50	
Weather service	1,937 10	
Armory—Furniture and equipment	890 90	
Abbott hall—Furniture and fixtures	1,663 55	
State Board of Agriculture rooms	341 69	
Farmers' institute	224 55	
Athletic apparatus	212 42	
Electric light plant, complete	5,000 00	
One dynamo at agricultural laboratory	280 00	
		45,653 52
		$512,786 84

United States property held in trust—		
Two 3-in. rifled guns and equipments	$1,573 55	
250 Springfield rifles, complete	3,750 00	
250 rifle equipments	665 00	
Reloading tools, chests, tarpaulins, etc.	313 69	
		$6,302 24

SUMMARY OF EXPERIMENT STATION INVENTORY.

Lands donated to the Station—		
80 acres at Grayling, fenced and improved at cost	$1,850 00	
5 acres at South Haven, fenced and improved	1,000 00	
		$2 850 00
Buildings—		
Experiment feed barn	$1,200 00	
Horticultural laboratory, experimental rooms	1,200 00	
Veterinary laboratory, experimental rooms	250 00	
Apiary	600 00	
Forcing houses, $1,500.00-$600.00	2,100 00	
Feed mill	100 00	
Sub faculty building	3,500 00	
Seed room	980 00	
Poultry house and yards	575 00	
Dairy room in agricultural laboratory	250 00	
Small poultry house and yards	250 00	
Storage barn	800 00	
Cold storage fruit house	1,000 00	
		12,805 00
Library and offices of director and secretary—		
1,795 books	$3,661 60	
Furniture and mailing list in type	657 00	
		4,318 60
Farm Department—		
Office and seed room	$426 75	
Piggery	58 15	
Tool and station barn	293 90	
Poultry	401 75	
Dairy room	70 50	
Growing crops	26 24	
Stock	299 00	
Apiary	310 10	
Class room	19 40	
Horse barn	10 00	
		1,915 79
Horticultural Department—		
Office, furniture, implements, etc.	$749 75	
One team	200 00	
		949 75
Chemical Department—		
Platinum ware	$210 00	
Glassware	443 29	
Furniture and fixtures	149 50	
Miscellaneous	120 55	
Chemicals	42 30	
Instruments, balances and weights	1,053 35	
		2,018 99
Botanical Department—		
Microscopes and accessories	$316 88	
Furniture and sundry apparatus	216 11	
		532 99
Bacteriological Department—		
Instrument and sundry apparatus	$1,448 08	
Chemicals	259 79	
		1,707
Zoological Department—		
Microscopes, cases, etc.		739 00
		$27,837 99

TABLE NO. 14.—*Detailed statement of Legislative appropriations to the State Agricultural College.*

Object.	Total.	1897.	1895.	1893.	1891.	1889.	1887.	1885.	1883.	1881.	1879.	1877.	1855–75.
Buildings	$234,325 00	Electric light plant..$5,000 Bath room, Abbot hall 200 $5,200 00	Closets.....$3,000 $3,000 00	Equip. botanical lab..$1,000 Foundry..... 1,500 Hospital..... 2,500 $5,000 00	Botanical labt'y....$10,000 Heating apparatus.. 1,950 Greenhouse..... 4,500 $16,450 00	Agricultural labt'y...$8,000 Sundry..... 1,800 $9,800 00	Howard terrace.....$10,000 Abbot hall..... 10,000 Horticultural labt'y 5,000 Mechanical labt'y... 3,000 Bridge, etc..... 2,100 $30,100 00	Mechanical labt'y...$7,800 Veterinary labt'y... 5,400 Armory..... 5,000 One dwelling..... 4,000 $22,200 00	Boiler house.....$5,000 One dwelling..... 3,000 $8,000 00	Library.....$25,000 Chemical labt'y add. 6,000 Barns..... 2,775 $33,775 00	Botanical laboratory $6,000 One dwelling..... 3,000 $9,000 00	Wells' hall.....$25,000 $25,000 00	Williams hall, 1869..$30,000 Chemical labt'y, 1871 10,000 Greenhouse, 1873.... 8,000 Three dwellings..... 18,000 Bridges..... 800 $66,800 00
General account	466,211 48	----	----	----	----	----	----	----	16,770 00	14,498 00	9,943 60	12,300 00	413,143 97
Repairs	77,428 60	12,000 00	12,000 00	13,500 00	7,800 00	5,000 00	1,400 00	3,147 00	6,720 00	1,576 00	1,290 00	3,691 60	9 264 00
Library	25,055 00	----	----	2,000 00	2,000 00	3,000 00	3,000 00	3,300 00	3,125 00	3,000 00	2,000 00	1,190 00	2,440 00
Farm	27,075 64	----	----	900 00	2,100 00	800 00	2 815 00	4,810 00	3,389 00	4,175 00	4,016 64	2,400 00	1,670 00
Garden	12,041 00	----	----	200 00	570 00	500 00	1,250 00	432 00	1,342 00	3,220 00	2,810 00	947 00	720 00
Greenhouse	2,765 00	----	----	----	530 00	600 00	340 00	1,295 00	----	----	----	----	----
Botany	5,331 00	----	----	----	500 00	1,000 00	800 00	800 00	2,231 00	----	----	----	----
Chemistry	13,955 00	----	----	----	500 00	1,500 00	2,000 00	2,500 00	1,000 00	3,000 00	1,000 00	1,380 00	1,075 00
Zoölogy	10,296 00	----	----	225 00	700 00	1,500 00	1,500 00	1,500 00	1,945 00	1,000 00	800 00	480 00	646 00
Veterinary	2,586 00	----	----	----	100 00	200 00	200 00	2,086 00	----	----	----	----	----
Mathematics	6,090 00	----	----	500 00	200 00	475 00	600 00	450 00	700 00	2,020 00	1,020 00	125 00	----
Mechanical	15,200 00	----	----	----	1,500 00	3,200 00	4,000 00	5,200 00	1,000 00	300 00	----	----	----
Steam and water	20,832 00	----	----	----	2,045 00	2,920 00	7,500 00	1,400 00	4,267 00	----	----	----	2,700 00
Institutes	20,800 00	11,000 00	10,000 00	4,000 00	1,500 00	800 00	600 00	600 00	600 00	600 00	600 00	500 00	----
Student labor	53,000 00	5,000 00	8,000 00	8,000 00	8,000 00	8,000 00	8,000 00	8,000 00	----	----	----	----	----
Weather service	19,937 50	2,000 00	2,000 00	----	----	8,350 00	8,587 50	----	----	----	----	----	----
Sundry	8,960 00	----	----	3,400 00	1,400 00	500 00	2,100 00	----	----	----	600 00	660 00	300 00
Totals	$1,007,899 22	$35,200 00	$35,000 00	$37,725 00	$45,895 00	$48,145 00	$74,792 50	$57,720 00	$51,089 00	$67,164 00	$33,080 24	$48,673 60	$498,858 97
Annual tax on each $1,000 of assessment.	† $0.488	$ 0155	$.0155	$.01⅔	$.02	$.02½	$.04	$.03⅓	$.03 1-7	$.04 1-7	$ 02⅝	$.04	$.0747
* Aggregate tax to date on each $1,000 of assessment.	----	$2 0989	$2.0679	$2.0369	$2.0036	$1.963	$1.912	$1.833	$1.7657	$1.7026	$1.6197	$1 5672	$1.4407
Assessed valuation of State in millions of dollars	----	1,105.10	1,130	1.130	1,130	945.45	945.45	810	810	810	630	630	137 to 630

* Counting only taxes actually levied and omitting land grants.

† Average.

TABLE NO. 15.—*Income of the State Agricultural College from all outside sources from the date of its foundation to the present time.*

Year.	From State Legislature.			From U. S. Congress.			Total.
	For current expenses.	For special purposes.	Land sales, salt spring and swamp land grants.	Morrill act of 1862, interest from land grant.	Hatch act of 1887, experiment station.	Morrill act of 1890, supplementary endowment.	
1855			$56,320 00				$56,320 00
1856							
1857	$40,000 00						40,000 00
1858							
1859	37,500 00						37,500 00
1860							
1861	6,500 00		152 25				6,652 25
1862	10,000 00		218 97				10,218 97
1863	9,000 00		407 80				9,407 80
1864	9,000 00		726 09				9,726 09
1865	15,000 00		1,156 61				16,156 61
1866	15,000 00		1,094 27				16,094 27
1867	20,000 00		7,608 38				27,608 38
1868	20,000 00		592 49				20,592 49
1869	20,000 00	$30,000 00	17,559 00	$58 96			67,617 96
1870	20,000 00		1,320 02	2,720 93			24,040 95
1871	18,250 00	10,500 00	4,135 72	3,785 84			36,671 56
1872	18,250 00	3,000 00	217 05	7,175 65			28,642 70
1873	21,796 00	15,602 00	10 13	11,059 06			48,467 19
1874	13,000 00	15,602 00	150 13	14,061 98			42,814 11
1875	7,638 00	7,755 50	144 53	14,446 14			29,984 17
1876	7,638 00	6,755 50	1,773 09	16,830 17			32,996 76
1877	6,150 00	30,686 80	979 06	15,172 86			52,988 72
1878	6,150 00	5,686 80	826 60	15,807 09			28,470 49
1879	4,971 80	16,068 32	712 22	16,978 22			38,730 56
1880	4,971 80	7,068 32	797 55	17,837 24			30,674 91
1881	7,249 00	43,720 50	461 95	20,935 25			72,366 70
1882	7,249 00	8,945 50	358 46	22,507 45			39,060 41
1883	8,385 00	23,793 00	391 95	30,749 60			63,319 55
1884	8,385 00	10,526 00	1,259 90	27,909 72			48,080 62
1885		35,103 00	187 50	29,770 40			65,060 90
1886		22,617 00		30,461 04			63,078 04
1887		* 44,040 00	† 198 20	† 24,611 37			68,849 57
1888		30,752 50	144 20	32,406 60	$15,000 00		78,603 30
1889		* 20,973 00	10 50	31,322 69	15,000 00		67,306 19
1890		* 27,172 00	238 50	32,360 64	15,000 00	$15,000 00	89,771 14
1891		22,947 50	37 38	34,750 54	15,000 00	16,000 00	88,735 42
1892		22,947 50	137 38	34,948 12	15,000 00	17,000 00	90,033 00
1893		18,862 50	10 50	37,927 04	15,000 00	18,000 00	87,800 04
1894		18,862 50	433 59	44,527 26	15,000 00	19,000 00	95,823 35
1895		‡ 19,000 00	10 50	45,301 85	15,000 00	20,000 00	99,312 35
1896		‡ 16,000 00		44,037 25	15,000 00	21,000 00	96,037 25
1897		‖ 17,700 00		43,779 54	15,000 00	22,000 00	98,479 54
1898		¶ 17,500 00		45,190 17	15,000 00	23,000 00	100,690 17
Totals	$362,083 60	$566,187 74	$101,082 47	$749,430 67	$165,000 00	$169,000 00	$2,114,784 13

* Including appropriations for weather service.

† Oct. 1, 1886, to June 30, 1887, nine months.

‡ Including $5,000 for institutes and $1,000 for weather service.

‖ Including $5,500 for institutes and $1,000 for weather service.

¶ Including $5,500 for institutes and $1,000 for weather service.

A SUMMARY OF THE RESOURCES OF THE STATE AGRICULTURAL COLLEGE.

Farm, buildings and equipments, as per inventory on pp. 21–22	$500,115 80
Agricultural College trust fund, from sale of lands of United States grant	625,780 26
Balance due on purchase money " " " " " " " "	85,470 23
88,311.73 acres @ $5 per acre as yet unsold " " " " " "	441,558 65
320 acres @ $4 per acre yet unsold of swamp land grant	1,600 00
Total	$1,654,524 94

The 88,311.73 acres yet vacant of the U. S. land grant are given in detail as located in the different counties in table No. 11, p. 16.

The 320 acres of swamp land is what still remains unsold of a grant from the State to the college of swamp lands located in the township of Bath, in Clinton county.

The present amount of the trust fund is taken from the last line of the fifth column of table No. 12, p. 17.

The balance due on purchase money is reported by the Commissioner of the State Land Office, and consists of the total amount for which the College lands have been sold up to the present time, *i. e.:*

The total of the fourth column from the right in table No. 10, p. 15	$769,702 29
Less the payments made on these sales, constituting the trust fund	625,780 26
	$143,922 03
And less balances unpaid on abandoned descriptions which have reverted to the State by forfeiture for non-payment of interest, as shown in the third column from the right, in table No. 10, page 15	58,451 80
	$85,470 23

DEPARTMENT REPORTS.

REPORT OF THE PRESIDENT.

To the Honorable State Board of Agriculture:

Gentlemen—I have the honor to submit herewith my report as president of the Michigan State Agrciultural College for the year ending June 30th, 1898.

As my two previous reports have been necessarily very brief, I shall in this report endeavor to give a more extended account of the work of the College since I took charge as president.

The College since it organization in 1857 has had six presidents: Pres. J. R. Williams served from '57 to '59. There was then an interregnum of three years, during the greater part of which time Prof. L. R. Fiske was acting president. Dr T. C. Abbot was president from 1862 until 1885. He was followed by Dr. Edwin Willets from '85 to '89—Dr O. Clute from '89 to '93—Prof. Lewis G. Gorton from '93 to '95. The present incumbent was elected Feb. 11, '96. He was present at the opening of the spring term Feb. 24th, but did not take full charge until March 20th. At this time the long vacation occurred from November to February, and a term was held during the summer months. It will be seen from this that he has had charge now eight terms, or two and one-third years.

At the first meeting of the State Board during the present administration it was decided to change the long vacation from winter to summer and during the winter in connection with the regular College work to offer special six-weeks courses in dairying, live stock husbandry, fruit culture, floriculture and winter vegatable gardening.

At the next meeting of the Board a resolution was passed providing for the addition to the College of a women's department. A four-year course of study for women was outlined and Abbot Hall was set apart for their exclusive use.

All these changes had been under discussion for some time by the Faculty, State Board and other friends of the College, and it was the almost unanimous opinion of those concerned that the proper time had come to make these inportant changes. The two years' experience under the new order of things vindicates the wisdom of the Board's action.

CHANGE OF LONG VACATION.

Conditions in Michigan have changed very much during the last forty years. When the College was opened the long vacation was placed in the winter, principally for the following reasons: It was held that practical agriculture could be taught to much better advantage during the summer months—that students could by work on the College farm during the summer defray to a large extent their expenses for board; that during the long winter vacation they could teach district schools and thereby earn enough together with their income from work on the farm to pay all their expenses. This plan worked well for many years, and was without doubt the best course to pursue at the time the College was founded and for many years thereafter.

But in time the farm became cleared, drained and fenced, and work could not be provided for a large body of students during the summer. The practical agriculture which could be taught during the harvest time was usually such as most students had learned, or could easily learn at home. The work of our country schools has so changed that very few good schools now have short winter terms, such as a student could teach during a winter vacation of three months.

It has been the policy of the College to endeavor to educate farmer boys for the farm; to give them such knowledge and inspiration along the various lines of agricultural work as would induce them to follow this calling after leaving College. The old system of having students teach during the winter was not conducive to this end. The young man after entering College was home only a few days at a time until he graduated. His experience in teaching usually made it easy for him to enter that profession after graduation.

Within the last few years the Mechanical and Women's Courses have been added. For the students of these two courses it is preferable to have the long vacation occur in the summer. Special short courses could be sucessful only if held in the winter, when busy men could leave home to attend them.

These and other reasons induced the Board to make the change. The results of the change have been very gratifying both to the Faculty and to the students. Practical agriculture is taught during the spring and fall. Students of agriculture who have not learned the ordinary operations of farm work before coming to College will be required to spend one long vacation on the College farm. It is believed that young men who spend their summers at home on the farm will be much more likely to return to the farm after graduation.

SPECIAL COURSES.

The change of the long vacation from winter to summer made it possible for the Board to carry out the plan of offering special courses in practical agriculture to those energetic farmers who could not find time to take a long College course. During the winter term of '96-'97 the College offered special six-weeks courses in the following: (1) Home dairying, (2) live stock husbandry, (3) fruit culture, (4) floriculture and winter vegetable growing. The classes had the following attendance: The first 18, the second 15, the third 10, and the fourth 2.

During the winter of '97-'98, in addition to the courses given the previous year, there were given also a four-weeks course in cheese making and a course of six weeks in dairy management and butter making. The course in cheese making was limited to a class of twenty members. It was under the able instruction of E. L. Aderhold of Wisconsin. Nearly all the students of this class were experienced cheese makers, and were thus prepared to receive a great deal of good from this course.

The other courses had the following attendance: Creamery management and butter making 26, home dairying 7, live stock husbandry 9, fruit culture 4.

While these courses were well advertised, there was no material increase in attendance over the preceding year. In some there was a decided dropping off.

Men ranging in age from fifteen to sixty-two years attended. They have almost without exception shown great interest in their work and have gone away from the College expressing themselves as well pleased with the attention and instruction given them.

These courses do not seem to have interfered in any way with the attendance or work of the long courses. The fear entertained by many friends of the College that the special courses would draw students away from the long courses does not seem to have been well founded. The four years course in agriculture is likely to gain more students than it will lose from the special courses. The history of the past two years indicates very plainly that while the special courses will be successful they will not attract to this College the large number of young farmers that have been attracted to the institutions of some of our western states. In such institutions the long courses in agriculture have very few students. The special courses are popular and attract to them many young men, who if they were residents of this State would enter our four-years course.

It will not be a matter of very great regret if our special courses do not attract more than fifty or seventy students each winter so long as a hundred or more enter our four-years course in agriculture each year.

WOMEN'S DEPARTMENT.

The Department for young women has been in operation for two years.

The design is to give a good college education in which the science and art of home-making shall be a prominent feature. We endeavor to so train young women that they will be able to apply science to the ordinary duties of the home. At the same time we give them a training in music, art, modern languages, literature, and such other studies as will develop them into broad minded, cultured women. The course as outlined attracted attention at once. It seems to meet in the minds of many people a long-felt want. As long as ninety per cent or more of our young women have later in life to take charge of their own homes or some other body's home, why should not their education to some degree at least prepare them for this work? Why should all that is practical be omitted from a young woman's education? Why should not science be compelled to relieve women of much of the drudgery of life, just as it has accomplished this for men?

When the College was thrown open to young women Abbot Hall was renovated and furnished for their use. An additional story was added to the rear wing and fitted up as a cooking laboratory.

Miss Edith F. McDermott, a graduate of Drexel Institute, Philadelphia, was placed at the head of the department. She also taught classes in cooking and acted as matron of the dormitory. During the first year 42 young women were enrolled, 17 of whom lived in Abbot Hall.

At the beginning of this, the second year, three teachers were added to this department—a matron, a teacher of sewing and an instructor in music. There have been in attendance this year 82 young women. During the greater part of the year Abbot Hall has been full. It will not accommodate more than forty.

The rapid growth of the department will make it necessary to provide more room in the near future or turn many young women away. A private boarding house is being erected on the delta north of the College. Arrangements have been made with the owner of this building, Mrs. Backus, to accommodate twelve young women next year.

Summary of students in attendance during this year.

	Agrl.	Mech'l.	Women's.	Totals.
Graduate Students				5
Class of '98	26	6	4	36
Class of '99	21	16	2	39
Class of '00	20	30	19	68
Class of '01	101	82	34	217
Specials	11	6	22	40
Total				405

Special short courses: Fruit, 4; cheese, 19; creamery, 26; farm dairy, 7; stock, 9.
Total short course, 65.
Total number of students, 470.

Number of students entering each year from 1887–97:

1887	128
1888	126
1889	127
1890	153
1891	132
1892	130
1893	131
1894	126
1895	145
1896	108
1897	135
1898	244

Number of students entering this year, not including those in special short courses:

	Male.	Female.	Total.
Number entering	190	54	244
Average age	19, 9 m.	22	
Median age	19, 4 m.	19, 7 m.	
Support while here:			
Father	103	35	138
Self	56	17	73
Father and self	24	2	26
Not given	6	----	6
Government	1	----	1

	Male.	Female.	Total.
Occupation of father:			
Farmer	92	21	113
Civil engineer	----	1	1
Minister	3	----	3
Lawyer	3	----	3
Merchant	16	4	20
Manufacturer	9	4	13
Insurance	4	2	6
Real estate	6	2	8
Physician	4	----	4
Traveling man	6	----	6
Railroading	5	----	5
Laborer	8	----	8
Clerk	8	2	10
Deceased	16	9	25
Miscellaneous	10	9	19
Proposed occupation after leaving college:			
Farming	45	----	45
Mechanical engineering	53	----	53
Teaching	14	18	32
Electrical engineering	4	----	4
Physician	2	----	2
Law	2	----	2
Not fully decided	70	36	106
Schools previously attended:			
High School	115	35	150
District	52	11	63
College	11	4	15
Private	12	4	16
Entered freshman class on			
High school diploma	46	13	59
Teacher's certificate	20	10	30
Standings from other colleges	----	5	5
Examination	93	15	108
Age	31	11	42

Counties represented in last freshman class:

Alger	1	Kalamazoo	7
Allegan	3	Kent	12
Barry	4	Lapeer	3
Bay	2	Lenawee	5
Benzie	2	Livingston	4
Berrien	7	Mackinac	1
Branch	1	Macomb	3
Calhoun	2	Marquette	1
Cass	7	Montcalm	3
Charlevoix	3	Monroe	1
Clinton	1	Oakland	11
Crawford	3	Oceana	1
Eaton	7	Osceola	1
Emmet	3	Ottawa	7
Genesee	8	Saginaw	11
Grand Traverse	1	Sanilac	2
Gratiot	2	Shiawassee	9
Hillsdale	4	St. Clair	3
Houghton	1	St. Joseph	4
Huron	4	Tuscola	3
Ingham	56	Van Buren	2
Ionia	6	Washtenaw	2
Isabella	1	Wayne	5
Jackson	4		

Indiana	1	Vermont	1
Illinois	1	Wisconsin	2
New York	1	Australia	1
Ohio	1	Turkey	1
Pennsylvania	1		

RECENT CHANGES IN FACULTY.

Dr. E. A. A. Grange resigned his position as Professor of Veterinary Science at the close of last year to accept the Deanship of the Detroit Veterinary College. Dr. Grange served the College very ably and faithfully for a period of fourteen years, during the greater part of which time he was also State Veterinarian.

Dr. Geo. A. Waterman, a graduate of the College with the class of '91 and since professor of Veterinary Science in the Storrs Agricultural College, was elected to the position made vacant by the resignation of Dr. Grange.

Mr. Cyrus C. Pashby, B. S., resigned as instructor in mathematics at the close of last year and Mr. W. O. Beal, a graduate of Earlham College, Ind., and Haverford College, Pa., was elected to fill the vacancy.

A. A. Crozier, assistant agriculturist of the Experiment Station, found it necessary on account of failing health to sever his connection with the College, June 15, 1898. Mr. Crozier has been connected with the College for about five years and during all this time rendered exceptionally valuable service. His fine qualities of mind and heart make his loss very much felt by all his associates. Mr. J. D. Towar, a graduate of the College with the class of '85, of the Rhode Island Experiment Station, was elected to the position of agriculturist of Experiment Station.

At the opening of the year Mrs. Jennie L. K. Haner, a graduate of Pratt Institute, Brooklyn, N. Y., was elected instructor in Sewing and Mrs. Harriet G. Bacon, Matron of the Women's Dormitory. Mrs. Maude Marshall was employed as instructor in Music.

At the close of the fall term Mr. Charles E. Hoyt, the efficient Foreman of the woodshops and foundry, resigned to accept a similar position in the Lewis Institute, Chicago. On account of dificulty in finding a person who could teach both woodwork and foundry, Mr. C. E. Baker was employed to teach the foundry work and Mr. W. R. Bradford to instruct in shop work and pattern making. These men have spent many years in productive work and their instruction is valuable from a practical standpoint.

The unusually large class necessitated the employment of assistant instructors in several departments.

Mr. Chace Newman, who for several years had been clerk to the head of the Mechanical Department, assisted in Mechanical Drawing and Shop Work.

Miss Lilian Wheeler, '93, assisted in mathematics.

Mrs. Linda E. Landon, librarian, taught two classes in English and Mrs. Ella Kedzie assisted one term in free hand drawing.

During the fall term Mr. D. B. Baldwin, College Engineer, resigned and Mr. L. F. Newell was elected to fill the vacancy. The heating and water department which had for some time been under the direction of the Mechinical Department was placed in charge of the College Engineer.

Mr. Thomas A. Durkin, who had been Foreman of the Horticultural Department for four years, resigned on May 1st, and Mr. Chas. Wood, Napoleon, Mich., was elected to this position.

FACULTY MEETINGS.

The President has had the coöperation and loyal support of all the members of the Faculty and teaching force. They have shown a ready willingness to carry out his plans and have spared no efforts to make the College successful in all its undertakings.

The weekly meetings of the Faculty were abandoned more than a year ago. The Faculty now meets on the first Monday of each month. Special meetings are called by the President when deemed necessary.

Matters of importance that would regularly come before the Faculty are referred before hand to the committee to which they naturally belong, or a special committee is appointed by the President to consider the case in hand. These committees report to the Faculty at its regular meetings and their reports are usually adopted without discussion. This method of procedure divides the work of the Faculty among the committees and does away with long weekly Faculty meetings. It is believed also that in a general way the work is better done than when discussed at length and settled by the Faculty as a whole.

STANDING COMMITTEES OF FACULTY.

Library—Edwards, Beal, F. S. Kedzie, Taft, Weil, Secretary.
Catalogue—Edwards, Taft, Butterfield.
M. S. Degree—Kedzie, Vedder, Smith, Miss McDormott.
Entrance Examinations—Barrows, Noble, Babcock.
Labor and Wages—President, Butterfield, Smith.
Excuse for Drill—Bandholtz, F. S. Kedzie, Weil.
Senior Courses—President, Smith, R. C. Kedzie, Edwards.
Excuse from Work—Taft, Smith, Weil.
Athletics—Vedder, Weil, Bandholtz.
Uniforms—Bandholtz, Butterfield.
Society and Entertainment—Edwards, Weil, Miss McDormott.

WEEKLY MEETINGS OF TEACHERS.

The teachers of freshmen meet on the second Monday evening of each month from five to six. The teachers of sophomores on the third Monday, and the teachers of juniors and seniors on the fourth Monday. In these meetings teachers compare notes and discuss the weakness and peculiarities of the different students under their care and are thus enabled to give encouragement and help where it is most needed.

These meetings bring professors and assistants of the different departments together and gives to each a better understanding of the work of the College outside of his own department.

The members of the Faculty do a great deal of work which is not directly associated with the instruction of students. In connection with Farmers' Institutes, the members of the Faculty during the winter of '95 and '96 did 74 weeks' work; in '96 and '97 they worked 50 weeks and in '97 and '98, 25 weeks. The change of the long vacation from winter to summer makes it much more difficult for members of the Faculty to do institute work.

This service was given without any expense to the State except for car fare and hotel bills. The College very frequently furnishes speakers for farmers' meetings, such as celebrations, picnics, grange meetings, etc.

The correspondence of a number of the departments is very large. Every day brings many letters of inquiry along the various lines of work carried on at the College. These are all carefully answered, which very often requires several hours of a professor's time. Some idea of the immense correspondence carried on by the College officers may be gained when attention is called to the fact that the College post office which is used almost exclusively by the College is a "presidential" or third class office.

The Experiment Station, which is a department of the College, issued sixteen bulletins during the year, containing about 450 pages.

RELIGIOUS EXERCISES.

As has been the custom since the College was first opened, brief religious exercises begin the work of each day. These exercises are conducted by the President or some member of the Faculty, and consist of scripture reading, singing from "Gospel Songs" and prayer.

The street car line was extended into the grounds last fall, thereby making the College particularly a part of the city of Lansing. It was thought advisable to try to induce each student to attend the church of his choice or own denomination in Lansing.

The regular preaching service held in the Chapel each Sunday afternoon and conducted by one of the Lansing ministers was discontinued and instead a chapel service, consisting of devotional exercises and an address, is held at 9 o'clock in the morning. These meetings are conducted by some member of the Faculty or prominent person from outside of the College.

The winter program was as follows:

President Snyder, "Martin Luther and the Reformation."
Dr. R. C. Kedzie, "The Forgiveness of Sin."
C. F. Hammond, Esq., Lansing, "John Calvin."
Dr. Howard Edwards, "John Knox."
Prof. Herbert Mumford, "John Wesley."
Prof. C. D. Smith, "Roger Williams."
C. B. Collingwood, Esq., Lansing, "Jonathan Edwards."
Prof. A. B. Noble, "Cardinal Newman."
Dr. Geo. B. Waterman, "Prof. Drummond."
Prof. Walter B. Barrows, "Henry Ward Beecher."

During the Spring Term the following program was successfully carried out:

April 10—Prof. J. C. Bartholf, Battle Creek, Mich., Editor of Youth's Instructor. "The Gospel of Individualism."

April 17—Prof. H. B. Laird, Supt. of Lansing Public Schools, "The Source of Light."

April 24—Hon. H. R. Pattengill, Ex-State Supt. of Public Instruction, "Made in America."

May 1—Rev. W. G. Sperry, D. D., President of Olivet College.

May 8—Hon. C. B. Grant, Chief Justice of the Supreme Court of Michigan, "Young Men and the Enforcement of Law."

May 15—Mrs. Cyrus Smith, Lansing, Mich., "Shakespear's Moral View of Life."

May 22—Mr. Rollo K. Bryan, Lansing, Mich., Founder of "Bethesda Mission." "A Chalk Talk."

May 29—Mr. Samuel Dickey, Albion, Mich., Chairman of the National Prohibition Party, "The Student and the Liquor Traffic."

June 5—Hon. Jason E. Hammond, Supt. of Public Instruction, "Self Examination on Year's Work in College."

June 12, 10:30—Rev. L. R. Fisk, D. D., Ex-Pres. of Albion College, Annual sermon to Y. W. C. A.

June 12, 8 p. m.—Rev. David McAlister, D. D., L. L. D., Pittsburg, Pa., Baccalaureate sermon, "Elements of Christian Patriotism."

Arrangements were made with the Lansing Electric Railway Co., by which the College was able to sell to students tickets good for one return trip each Sunday for term for twenty-five cents. With very few exceptions the students purchased these tickets and from the return coupons it has been found that on the average more than 70 per cent of our students living on the College grounds attended services at the Lansing churches each Sunday.

With good street car facilities at a nominal cost there is no reason why every young man and young woman who attends church when at home should not attend his own church regularly in Lansing. This we encourage students to do. The Lansing pastors welcome them gladly and they soon become acquainted and find a congenial church home.

The Young Men's Christian Association is a strong organization and does much good. It has fifty active members. It meets regularly on Thursday and Sunday evenings, and also carries on several classes in bible study. It has a large, comfortable room, neatly furnished, in Williams Hall, where its regular meetings are held.

The Young Women's Christian Association is comparatively young but is growing and has done very commendable work during the two years of its existance. It holds a regular meeting each Thursday evening and a union meeting with the Y. M. C. A. Sunday evenings.

Of the 217 freshmen who entered College last September, about 50 per cent were church members. These were divided among the various denominations about as follows: Methodist, 29 per cent; Congregationalists, 21 per cent; Presbyterian, 13 per cent; Episcopalian, 10 per cent; others, 27 per cent.

Many of those who are not church members belong to Christian families and are regular attendants.

The upper classes would likely show a much larger percentage of church membership as quite a number unite with the church during the period between entering College and graduation.

The religious and moral standard among the students is high. Swearing, obscene language, boistrous or unbecoming conduct at ball games or other times are very rarely if ever indulged in by students. The College can certainly feel proud of its clean, honorable, upright body of students.

Though not a sectarian institution, the Faculty is composed of Christian men and women who do not feel that their responsibility ends with class room instruction. They realize that better than knowledge gained from books or in the laboratory is a strong Christian character and above all other considerations they endeavor to impress their students with a keen sense of the realization of this great truth.

DISCIPLINE.

For more than twenty years, 1876-1896, the discipline of the College was intrusted to the student body.

The students carefully organized for this purpose under the direction and with the support of the Faculty, and adopted a constitution, by-laws and such other regulations as were deemed necessary to carry out a complete system of self government.

Prof. Geo. T. Fairchild, who was then at the head of the English Department and who was for many years the honored and efficient president of the Kansas Agricultural College, took a very active part in perfecting this organization. All the original documents are in his hand writing, and bear the impress of his cool, discriminating judgment. This fact is mentioned here to show that the plan was undertaken with great care and deliberation on the part of the Faculty and was given, at least during its inception, all the support and encouragement possible by the members of the Faculty.

At that time the College was well adapted for the successful carrying out of such a plan. The number of students—less than two hundred—was not too large; there was but one course of study hence their interests were the same; they nearly all lived in the dormitories on the grounds and could be summoned together quickly and easily; the isolation of the College rendered it free from outside influence such as come to schools located within village or city limits.

As to the real success of the organization in carrying out the purposes for which it was originated the opinion of those who ought to know differs somewhat. From a limited opportunity to examine the College records and minutes of the Student Organization during these years I am led to believe that when the students took an interest in their organization and elected, strong, popular students as officers, the self government plan worked quite satisfactorily to both students and Faculty. On the other hand it is quite evident that very often the organization drifted into the hands of those least fitted to control in such matters. When this occurred discipline became lax and often the Faculty was compelled to mete out punishment regardless of the wishes of the organization.

During the fall term of '96 the students' organization was at a very low ebb. The better element among the students were willing to give it up. The Faculty were equally willing to assume control. During the winter term the Faculty quietly exercised its authority and student government was a thing of the past at M. A. C. So quietly was the transition made that it is difficult to fix the exact time. No protests came from students. They seemed perfectly willing to relinquish all claims to authority and allow the Faculty to shoulder the responsibility and assume entire control.

A great many colleges have in recent years endeavored to carry out the student government idea, but in most cases the efforts have been of short duration. That such a plan should succeed in this College for more than twenty years is remarkable and probably stands without a parallel in the history of self government by college students.

The function of government in a college belongs to the President and Faculty. They are the governing board of all college matters and are in much better position to judge intelligently than is any body of students, however honorable and fair minded it may be.

The Faculty may delegate and transfer much of its authority to the student body, but this does not relieve it of one iota of the responsibility in connection with the successful management of the institution under its control. Patrons of the College and the public in general will hold the Faculty, and that very properly too, responsible for the way in which the institution is conducted. Why, then, should a Faculty give over to students' authority when it must from the very nature of the case stand responsible for whatever action they may take? To clothe them with the authority to try, convict and punish their fellow students certainly will not contribute to their development either as scholars or as law abiding citizens. Upon inexperienced young men it is very likely to have the very opposite effect.

Student government, with the earnest support of the Faculty, may succeed for a time, but the general experience seems to be that the better element among the students, busy as they are with their work, soon become tired looking after their recreant brethren and lose interest in the plan. The organization then becomes inoperative or is controlled by an irresponsible class of students.

CONTROL OF DORMITORIES.

About two hundred thirty young men live in Willams and Wells' Halls and the large Harrison House, which has been rented by the College for the accommodation of students. A member of the Faculty, during the past two terms, Prof. W. O. Hedrick, looks after the care of students' rooms and order in the dormitories. The buildings are divided into six wards, each of which is under the care and supervision of a student appointed for this service by the professor in charge. He is usually an upper classman and also a high officer in the millitary department of the College. It is part of his duty to inspect every room at a designated time each morning and report failure on the part of any student to keep his room in a neat and sanitary condition. Regulations with reference to the cleanliness and care of rooms are very rigid and prompt compliance with these rules is insisted upon.

This inspecting officer is also held responsible for the conduct of students in his ward. He is required to report to his superior officer all violations of rules or misconduct of any nature.

The order in the dormitories during the past year has been very good. In two instances students who were inclined to be mischievous were promptly ejected and required to room outside the grounds.

The inspecting officers are paid eight dollars per term and their tenure of office depends altogether upon the faithfulness with which they do their work. Strong men are selected and so far they have been equal to every emergency that has arisen.

Abbot Hall, the women's dormitory, is under the care of a matron.

During last summer vacation every room in Wells and Willams Halls was thoroughly fumigated. Sulphur was burned in each room from six to seven hours. All furniture was fumigated and then varnished. In this way the dormitories were thoroughly cleansed and put into a first class sanitary condition. A special inspector has made a thorough inspection of every room and furniture several times during the year and reported all conditions as very satisfactory.

Average room-rent per term in Wells Hall	$4 92
" " " " " " Williams Hall	5 36
" " " " " " Abbot Hall	7 75
" " " " " " Harrison Hall	4 98

It is believed that these dormitories furnish much better accommodations than could be obtained in ordinary dwelling houses and at a very much less cost. On the average the cost does not exceed twenty dollars per year for each student, including steam heat and electric light.

Is it not also true that students are much freer from temptation and less likely to go wrong than when scattered over a city and not under the direct care of anyone? If a student in a dormitory becomes reckless or acquires bad habits it becomes known at once and there is a chance to work a reformation before he is too far gone to be reclaimed, whereas, if he with one or two other students is rooming with a private family he may be very far gone before it comes to the attention of the College authorities.

GENERAL DISCIPLINE.

In dealing with matter of discipline the Faculty has empowered the President, when any case needing attention arises, to call to his assistance such members of the Faculty as he may choose who, acting as a committee may investigate the matter and impose such punishment as the case in their judgment demands. At the next Faculty meeting the President reads the history of the case, giving the names of the committee, and the action taken, and this report is made a part of the Faculty minutes. The action of the committee is final and is not subject to the approval of the Faculty.

In this way the Faculty is often relieved of annoyance and judgment comes swift and sure to the wrong doer.

There have been very few cases of misconduct during the year.

THE CLUB BOARDING ASSOCIATION

is composed of all students who live on the grounds. When a student enters college he is required, if he boards in a club, to purchase a boarding certificate which eititles him to all the privileges of the association. The members of the association are assigned to clubs of which there are six. Each club has its own kitchen, dining room, cook and waitresses, and can accommodate from fifty to sixty persons.

The general control of the association is in the hands of a board of managers composed of one representative from each club and the President of the College. Each club is under the direction of a steward who is elected by members of said club and who serves for one term. He employs the cook, buys provisions and is responsible for the management of the affairs of the club. For this service he receives twenty dollars per term.

The Board of Managers elect a bookkeeper who must be approved by the Faculty. All money is paid out by vouchers and the books are carefully audited at the end of each term. The Secretary of the College is the treasurer of the association.

The expenses of each club are divided equally among the members of that club.

At the beginning of this year a few students, who desired substantial board at the lowest possible cost organized an independent boarding club.

The average cost of board per week in each of the different clubs during the year was as follows:

	Average No. for year.	Average price.
Club A	47	$2 30
Club B	37	2 46
Club C (womens club)	38	1 53
Club D	51	2 14
Club E	50	2 22
Club F	28	1 83
Club X (independent club)	32	1 45
Average		1 98

The association has been very well managed and the question of board for students has given the College authorities very little trouble or care during the last few years. Occasionally on account of an inefficient steward or a poor cook a club may have trouble, but matters are righted very soon.

Very few students—not more than eight or ten—have done their own cooking during the year. This plan is discouraged, and when a student is so short of funds as to absolutely require such a course on his part, those in authority endeavor to find some work which will enable him to earn enough to pay his board in a club.

IMPROVEMENTS.

During the last four years, from January '95 to January '96, the college has been granted each year $6,000 by the State for repairs, and $3,000 for the years '95 and '96 for closets, and $5,000 for 1897 for an electric light plant. As it requires the full amount of $6,000 per year to keep the buildings, heating, sewers and water plants in good condition, there has been nothing left from these funds to apply to permanent improvements. The College has, however, used current fees to make a number of necessary additions to buildings which should have been done by appropriations by the State.

From the special appropriation toilet rooms have been placed in Williams, Wells and Abbot Halls, making these dormitories up to date in modern conveniences. These improvements were made two years ago and cost $3,000.

With the introduction of the Women's Department, it became necessary to have a cooking laboratory. As no suitable vacant room could be found, it was deemed advisable to add another story to the rear wing of Abbot Hall, making it two stories—the same height as the other part of the building. This was done at a cost of about twelve hundred dollars. While the room is not first class in all particulars, it answers quite well the purposes for which it was intended.

The steam heating system has been extended at a cost of over one thousand dollars to the Agricultural and Veterinary Laboratories. It is now used in seven of the largest buildings and will be extended to College Hall during the coming vacation.

The hot water furnace previously used in the Agricultural Laboratory was placed in the Armory and the building properly piped for a hot water system. It has given excellent satisfaction. The entire cost was about three hundred dollars.

A dairy barn for the accommodation of thirty cows has been added to the equipment of the Farm Department. The cost was eight hundred dollars.

Changes were made in the basement story of the agricultural building and several hundred dollars' worth of apparatus added for the special courses in dairying and cheesemaking.

Good bath rooms were placed in Abbot Hall and the bath house for young men was repaired and several shower baths added. The total cost for both was over four hundred dollars.

At the last regular meeting of the State Legislature, the College was granted five thousand dollars for the installation of an electric lighting plant.

For the last three or four years up to last January, the College grounds and a few of the College buildings had been lighted by an improvised system erected by the students under the charge of Prof. Woodworth. The dynamo was taken from a junk pile and much of the other apparatus had been purchased second hand and cost but a trifle. This was just a little better than no lights, and consequently the grant of $5,000, though entirely too small to purchase such a system as was desired, was very much appreciated.

To know in what way to use this appropriation to best advantage was a perplexing question, but after many conferences and considerable delay, it was finally decided to enter into a contract with A. A. Piatt of Lansing to furnish water power to run a dynamo. Thereupon the College purchased a fifteen hundred light Tesla Polyphase generator dynamo and placed it in Mr. Piatt's power house, southwest part of city of Lansing. Mr. Piatt erected line to College at an expense of over $2,000.00, furnishes power and attendance to run dynamo continuously, if desired, and on a five year contract receives $1,550 per year. This contract also includes current to run motor for farm department, which requires power to cut fodder, grind feed, run churns, cream separators, etc. The voltage of transmission from the power house to College is 2,000, which is reduced by transformer to 110 before entering buildings.

By this arrangement the College was enabled to purchase a first class dynamo and wire all the College buildings with material of the best quality. Bids were received for wiring and the contract was let to the Capitol Electric Lighting Co., of Lansing. All work was done in accordance with the rules laid down by the State Board of Underwriters and each building was carefully inspected by the State Inspector, who issued a certificate accordingly. These certificates are deposited with the Secretary of the College.

The present lighting system has been in operation since January first and has run without a break. It has in every way given excellent satisfaction.

Each employé of the College, each society, boarding club, etc., pays for lights used. The members of the Faculty pay from $12 to $30 each; society and boarding clubs $20 each per annum. The room-rent of each student was increased seventy-five cents per term when electric lights were placed in rooms. The income of the College from all sources for lights is about $1,350 per year.

In addition to this income, the College class rooms, library, laboratories, offices and grounds are all well lighted.

There was placed in Station Terrace a complete hot water system costing about four hundred dollars.

The Experiment Station erected a large side hill forcing house during the summer of '96 at an outlay of $600.

A cold storage fruit house was also erected by the Experiment Station costing $1,000. This building was made to conform to the latest approved plans for such buildings and serves as a model for the fruit growers of the State.

Perhaps of all the improvements made recently the one appreciated most by students and visitors is the extension of the street car line into the College grounds. The line now enters the campus from the north and extends to the stone walk between Station Terrace and the dwelling house occupied by Dr. Edwards. As the State Board of Agriculture did not deem it wise to allow a corporation any rights on the College campus that portion of the road—600 feet—on College property was built by the College at a cost of $360. A neat waiting station has been placed at the terminus of the road and a new cement walk has been laid to join with other walks at College Hall.

Many other improvements of a minor nature have been made during the year, and while there are many other repairs and improvements which should be made, yet on the whole the buildings and grounds are at present in good condition.

EXCURSIONS TO THE COLLEGE.

Arrangements were made with the railroads to run excursions to the College last summer. August 17 the Grand Trunk sold excursion tickets from Battle Creek and intermediate stations. Over three hundred persons came to the College on this excursion.

The D., G. R. & W. ran an excursion from Holland and Grand Rapids on August 19 and landed about thirteen hundred people at the College. The same road on August 20 ran an excursion from Greenville and intermediate stations from the north, and from Plymouth from the east. It was estimated that about fourteen hundred visited the College on this day.

Nearly all of the visitors to the College with these excursions were good, substantial farmers, who, while interested in the College, had never been on the campus before. As is usual with persons who visit the College for the first time, they were very happily surprised at the beauty of the campus and the number and character of the buildings. The library, laboratories, museum green houses, dormitories, barns, gardens, orchards and farm were thoroughly and critically inspected. Many very favorable comments were heard from the visitors and all seemed much pleased with their visit.

It is believed that by means of these cheap excursions many farmers can be induced to visit the College each summer, and as "seeing is believing" in most cases with those who visit the College, may we not hope that through this agency the farmers of the State will come to know the College better and appreciate more fully what the College is doing for the agricultural interests of the State?

The excursions scheduled for next season are as follows:

1. Tuesday, August 16, Michigan Central R. R.: From Wayne, Ann Arbor, Jackson and intermediate points, to Lansing and return.
2. Wednesday, August 17, Grand Trunk R. R.: From points east of Lansing on C. & G. T. R. R. to Port Huron; from Pontiac and points intermediate to Durand on D., G. H. & M., and from all points on C., S. & M., to Lansing and return.
3. Thursday, August 18, Michigan Central R. R.: From Bay City and intermediate points (also on Ann Arbor R. R. from points between Mt. Pleasant and Owosso Junction) to Lansing and return.
4. Friday, August 19, Lake Shore R. R. (Lansing division): Hillsdale and intermediate points, to Lansing and return.

ADVERTISING.

With the very able assistance of the College Field Agent, Mr. K. L. Butterfield, a systematic course in advertising has been carried out. During this year there have been carefully distributed 5,000 College calendars, 18,000 envelope catalogues and 10,000 copies of the College year book, or perhaps more properly called the farmer's almanac. Nearly 5,000 copies of the regular College catalogue have been distributed, principally upon request. In addition to the above, many thousand copies of special circulars have been issued.

Special editions of the Record have been sent to over 6,000 young people of the State whose names have been sent to us by responsible parties. A limited amount of space in the agricultural, religious and educational papers of the State has been utilized at times during the year best suited to our needs.

A very large correspondence has been carried on by the President with young people anxious to secure a higher education. Every request for a catalogue has been honored and in addition a personal letter sent to the inquirer.

In all letters and publications the true purposes of the College have been emphasized. No bid has been made for students who expect to enter one of the learned professions, except, of course, the profession of Mechanical Engineering.

RESULTS OF LAST YEAR'S ADVERTISING.

Soon after the present school year opened a circular of inquiry as to the influences which persuaded each student to enter this College was sent to all the new students. One hundred seventy-nine replies were received. These are conflicting in many respects and perhaps do not signify anything very definitely.

The circular submitted, with the number of students answering each question in the affirmative, is given below:

President's Office, Agricultural College, Mich., Oct. 8, 1897.

Please designate which of the following influences affected your decision to attend M. A. C.:

		14	15	16
1. Any graduate of M. A. C.	62	32	17	13
2. Any former student who did not graduate	52	32	18	16
3. Any farmer not in the above two classes	12	6	3	1
4. a. Any school teacher of yours	34			
Was he a graduate or former student of this college	18	10	6	6
5. Any college circulars that you read	26	10	8	4
6. A catalogue of the college	101	50	37	43
7. An advertisement in a newspaper	7	3	2	2
8. "The M. A. C. Record"	44	14	27	10
9. Any visit to the college by yourself or friends	62	19	16	22
10. Anything said or done in any Grange or Farmers' Club	6	3	2	..
11. Attending Farmens' institutes by yourself or parents	18	6	6	2
12. Interview with M. A. C. professors	21	5	7	8
13. Letters from the President of any other official of the college	57	12	12	21

14. Which of the above, directly or indirectly, *first started* you to think of attending this college? See column 14.
15. Which of the above were most influential in keeping yourself or your parents *interested* in the college? See column 15.
16. Which of the above causes finally *decided* you, or were most influential in deciding you to enter? See column 16.

Members of the Board, and other interested parties, are referred for further details concerning the several departments of the College to the department reports published in full each year in the report of the State Board of Agriculture.

J. L. SNYDER,
President.

DEPARTMENT OF PRACTICAL AGRICULTURE.

To the President:

Sir—I have the honor to submit herewith the annual report of the Department of Practical Agriculture for the year ending June 30, 1898:

CLASS INSTRUCTION.

In order that people who read the published reports of the Board may have a more accurate conception of the instruction given in this department of the College, I shall include in this report, with a statement of the work done, a partial list of the examination questions given the different classes. These questions will indicate the ground gone over and the character of the instruction, since it may be fairly assumed that the work in the class room, laboratory, stock barns and yards and fields is of such a nature and is so conducted as to fully fit the student to give full and accurate answers to the examination questions.

The entering class began at the commencement of the fall term of 1897 the study of live stock taking up, in connection with the history of the different breeds of horses, cattle, sheep and swine, practical work in stock judging. There was given each day a lecture on the history and characteristics of some breed, which was followed the next hour by work in the yard judging, with or without the score card, as the case might be, specimens of the different breeds as far as they were found in the College herd. Here follows a list of the questions on the final examination, after ten weeks study daily, two hours per day:

QUESTIONS FOR CLASS IN STOCK JUDGING.

1. Name the advantages and disadvantages of the use of the score card in judging stock.
2. With what should every animal to be judged be compared?
3. Where it is possible, what is the best test of an animal's worth for a certain purpose?
4. In your judgment, what variety of stock is hardest to judge? Give your reasons.
5. What do you understand by quality in an animal, and how judged?
6. In selecting a dairy cow for breeding or the dairy herd, what four points should be most considered, and describe how they should appear in a perfect animal.
7. State the characteristic differences between the dairy and beef type.
8. Write out as much as you can of the score card for swine, giving the different points to be observed, and the estimated numerical value.

9. Name the four most important points of (a) mutton sheep, (b) draft horses. Tell in each case how the points should be developed.

10. Indicate the various points of the horse by numbering the cut furnished you so the numbers will correspond to the various parts enumerated below the cut.

In addition to the above the class is required to score some one animal and rank three or four animals according to their individual merit. They are also required to distinguish the breed to which the different animals on the College farm belong.

QUESTIONS FOR CLASS IN BREEDS AND THEIR CHARACTERISTICS.

HORSES.

1. What country is supposed to be the native home of the horse? Give reasons for such belief.

2. Describe the best known and most important Asiatic and African types of early horses.

3. Name and classify, according to their uses, the breeds of horses known at the present time.

4. Give description, origin, characteristics and history of the Percheron horse.

5. Give characteristics, differences and similarities between the English Shire and the Clydesdale.

6. From what sources did the draft horses get their size, for the most part?

7. What are the objections to the Suffolk-Punch as a draft horse?

8. Name, describe and give characteristics of the two classes of coach horses most highly prized in the United States.

9. Explain the differences in type in the English Thoroughbred, Hackney and Hunter.

10. What was the principal source of blood in building up the American trotter? Name seven horses which were prominent in the early history of the trotter, and five leading families of the present time.

CATTLE.

1. Name the breeds of cattle known in the United States, classify them and indicate in each case the following points: 1. Color; 2. In what country did they originate; 3. Size.

2. Write as good a history of the Shorthorn cattle as you can with 150 words.

3. Who is considered the founder of the Hereford breed of cattle? About what time did he begin breeding, and what two strains, or families, did he originate?

4. What breed of English cattle was most highly prized and generally used in New England during the early history of this country?

5. Give origin, description, history and characteristics of the Red Polled cattle.

6. Name the Scotch breeds of cattle, and tell the two things for which all Scotch cattle are noted.

7. Tell how the Galloway and Polled Angus resemble each other, and in what points they differ.

8. Name, describe and give characteristics of the Channel Island breed of cattle.

9. Where did the Kerry cattle originate, and for what are they noted?

10. Explain the differences between the Ayrshire and Holstein-Friesain breeds of dairy cattle.

SHEEP.

1. Answer the following questions in regard to Merino Sheep:
   (a) Name classes and sub-classes of Merino Sheep.
   (b) What were the most important importations of Merino Sheep to the United States, and when were they made?
   (c) What did the introduction of Merino Sheep into the United States do to improve the sheep industry of this country?
   (d) In what state did the greatest amount of improvement in Merino take place?
   (e) Name three of the most popular classes of Merino at present.

2. Mention the middle wooled sheep in the order of their size, beginning with the smallest.

3. Describe, give origin, history, and the characteristics of the Dorset Horned breed.

4. Answer the following questions in regard to middle wooled sheep which aid in distinguishing them:
   (a) Which is the largest, and what was its origin?
   (b) Which has the blackest face?
   (c) Which has the lightest face?
   (d) Which has the most wool over the head and face?
   (e) Which is said to produce the best quality of mutton?

5. Which are the long wooled breeds; describe, give origin, history and characteristics of the most popular of the long wooled breeds.

HOGS.

1. Name and classify the breeds of swine according to size. Indicate in each instance the color, and the country in which they originated.

2. Give in detail the history of the Poland-Chinas. What characteristics do they possess that have made them so universally popular?

3. Upon what two early types of hogs have our modern breeds been built up, and in what way have these types been mated?

4. Give points of similarity and difference between the Essex and the small Yorkshire.

5. State description and characteristics of the Duroc-Jerseys.

6. Explain the difference in type between the Chester-White and the Poland-China.

7. What portion of the hogs of the world are grown in the United States?

8. When did the improvement of swine begin?

9. Tell all you can about Cheshire swine.

10. Give an account of Victoria swine.

MECHANICAL ANALYSIS OF SOILS.

The last four weeks of the fall term were devoted, as far as this department was concerned, to a study of the mechanical analysis of soils. This work was to occupy the attention of the student for two hours per day five days in the week, but the class was too large to be handled together, and was therefore divided into two sections, each of which had the work for two weeks only. To the students the whole idea of mechanical analysis of soils was new. It was not to be expected, therefore, that much progress would be made in the short time allowed, but the work was a good preliminary step to the studies of the spring term to follow.

In the spring term of 1898 the work with soils was continued with the Freshman class by a course of daily lectures covering the first four weeks of the term. As that series was completed, an examination on the topics covered was given.

The remainder of the term was devoted to a careful study of fences, poultry, bees and a preliminary study of farm crops. In the examination at the end of the term these questions were used:—

FENCES.

1. Describe in detail the anchoring and setting of end posts for a wire fence.
2. What qualities should a fence stay have? Mention some fences with satisfactory stays.
3. Describe the M. A. C. fence, giving distance apart of posts and stays, height of fence, and number, size and spacing of wire for horse and cattle fences.

POULTRY.

1. Name three principal breeds of the American class, and give some of the qualifications of each.
2. Name one breed in the Asiatic class and the same in the Mediterranean.
3. What breed have you studied in the English class?
4. Name and describe the comb of a Wyandotte and of a Dark Brahma, and the penciling of the Partridge Cochin hen.
5. Describe the feeding and care of laying hens. Of young chickens.

BEES.

1. Describe method of wintering bees in cellar. On the summer stand.
2. What care should they receive in the spring?
3. What condition should all colonies be in at the beginning of the honey flow? When should surplus cases be put on?
4. Give briefly method of hiving swarms.
5. What objects are gained by clipping queens?

FARM CROPS.

1. Name a weed that you have analyzed belonging to the cruciferae. Others belonging to the polygonaceae.

2. What tool do you use to begin the cultivation of a cornfield?
3. Briefly state some peculiarities of narrow leaved plantain and its seeds.
4. For what purpose did we sow oats and peas?
5. Describe in detail the preparation of ground for sugar beets.
6. How far apart should the rows of corn be?

The *Sophomores* reported to this department in the fall term two hours per day for farm work. In the winter term they were given a course of lectures on stock feeding. These lectures came daily for the first six weeks of the term and were devoted to a discussion of the composition and methods of growing and preparation of the different classes of coarse fodders and grain feeds, a discussion of the differences in construction of the digestive apparatus of the different classes of animals, and, finally, the best methods of feeding for growth, fattening, or production of milk. The agricultural course, as now arranged, contemplates an election by the student, at the close of the first term of the Junior year, of the line of work to which he shall devote himself for the remainder of his course. It is necessary to give the young men who elect work in horticulture some instruction in stock feeding; hence this course of lectures was provided. Below are given the examination questions:

EXAMINATION QUESTIONS IN SOPHOMORE STOCK FEEDING.

1. Define and illustrate the meaning of the term protein. Distinguish it from carbo-hydrates and from fat.
2. In what way do carbo-hydrates and fat differ in composition?
3. Define the expression "standard ration," and give the M. A. C. standard for dairy cows.
4. What is the period of gestation in a cow?
5. Describe the feeding of the calf to the time of the birth of her first calf.
6. When may milk fever be expected, and how do you prevent it?
7. Describe the digestive system of the cow and give the functions of each organ.
8. Mention five grain foods suitable to dairy cows, and arrange them in order of richness in protein, the richest first.
9. Write down a good ration for a dairy cow with silage as a basis. The same with clover hay as a basis.
10. Describe a good cow stall, and state what is required in a cow barn—(a) temperature, (b) arrangement, (c) light, (d) ventilation.
11. How do the digestive systems of the cow and horse differ?
12. Describe the care of a work team in hot weather at hard work.
13. Outline the care of the brood mare before foaling and for the month following.
14. Give the feed of a brood sow before and after pigging.
15. Give the care of the pen of fattening pigs.
16. How can you tell the age of a sheep? Describe the care of a flock of breeding ewes through the winter.

In the last half of the winter term, Sophomore year, the agricultural students take work in dairying, twelve and one-half hours per week. Their time is devoted principally to practical work in butter making, using such utensils as they should have upon their own farms. The Babcock test, the lactometer, the acid test and other modern appliances are studied until the students are familiar with their use. The examination consisted in making from a given quantity of milk an excellent article of butter, with a minimum loss of fat in the skim milk and butter milk.

In the fall term the *Juniors* reported to the Farm Department three times per week for work in stock feeding. A course of forty lectures was given, covering the ground described for the Sophomores in the winter term, but going into the details much more thoroughly and carrying the subject much farther. The following list will indicate, though but incompletely, the scope of the instruction:

SUBJECTS OF LECTURES ON STOCK FEEDING DELIVERED TO THE JUNIOR CLASS.

SPRING TERM, 1898.

1. Introduction.
2. Composition of animal body.
3. The same.
4. Composition of food plants.
5. Digestion.
6. Digestion.
7. Absorption and secretion.
8. Circulation, respiration and excretion.
9. Review of chemistry of feeding stuffs.
10. Digestibility and feeding rations.
11. Calculation of rations.
12. The same.
13. Review and examination on work to date.
14. The coarse fodders—silage and silos.
15. Construction of silos.
16. Hay—clover and legumes, timothy and grasses.
17. Concentrated feeding stuffs.
18. Roots, tubers and feeding stuffs generally.
19. Feeding horses—peculiarities of digestive system.
20. The brood mare and colt.
21. Young horses—draft horses.
22. Daily routine in stable and field.
23. Carriage horses.
24. Review and examination on work to date.
25. Selection of dairy stock.
26. Care of the bull and pregnant cows.
27. Care of calves and young animals.
28. Feeding of matured cows.
29. The same.
30. Feeding steers.
31. The same.
32. Feeding sheep—the breeding ewe.
33. Care of the ewe and lamb. Early lambs.
34. Fattening wethers and lambs.
35. Feeding swine—the sow.
36. Pig pens and care of growing swine.

37. Fattening pigs.
38. Review of last thirteen exercises.
39. General review and examination.
40. General review and examination.

One hour daily for the last half of the winter term, Junior year, was occupied by a course of lectures on stock breeding and management. A part of the list of questions used in examinations follow:

REGULAR EXAMINATION IN STOCK BREEDING FOR JUNIORS OF THE CLASS OF 1899.

1. Tell all you can concerning heredity (discussing questions related to the subject not included in questions 2 and 3) in 15 minutes.

2. (a) Define the following terms as related to the "Heredity and Diseases"—structural and functional diseases—congenital and predisposed. (b) Name two of the above classes of diseases most liable to be transmitted. (c) How is tuberculosis supposed to be inherited?

3. Define the following terms—feral, immune, acquired characters and period of gestation.

4. Name the classes of animals most liable to vary; explain and give an example of each.

5. Mention the conditions which tend to induce variation, and give an example illustrating the variation resulting from such conditions.

6. State eight general rules for selection, and explain significance of each briefly.

7. (a) Distinguish between a pedigree and a "Certificate of Registry." (b) What constitutes a good pedigree?

8. Give following information in regard to shipping stock: (a) Cost of D. D. Hog car from most southern Michigan points to Buffalo. (b) Usual commissions for selling car cattle, sheep, pigs. (c) State yardage rates and cost of feed.

9. What margin over local prices in shipping cattle, sheep and hogs to Buffalo market should be expected to protect shipper against loss? State average pounds of shrinkage on above classes of stock.

10. Write all you have time to write on the subject of "The Relative Influence of Parents on the Offspring."

11. What do you understand by "In-and-in-Breeding?" Give two examples.

12. Name three advantages and three disadvantages of such a practice.

13. When can a system of in an-in or line breeding be safely practiced, if ever?

14. State three advantages which generally follow a judicious system of cross-breeding. When is cross-breeding to be advised?

15. Give four theories which have been advanced by scientists and breeders as possible methods of breeding a desired sex. If a stock breeder, how would you attempt to produce a majority of the one sex or the other, if such a result would be an advantage?

16. Discuss the subject of the "Effect of over-feeding on animal organism," "Fatty degenerations," "Adipose tissue."

17. Name the conditions, besides the quantity of food consumed, that affect fecundity. Explain and give an example under each condition.

18. What is the general belief in regard to the influence of a "Previous impregnation?" Discuss two theories advanced as possible explanation.

19. State briefly your idea in regard to "Intra-uterine influence," and give examples illustrating what you say.

The *Seniors* have no class work in this department. except in the closing term of the course. Ten weeks are devoted to a study of the rules of law that govern the farmer in his relation to his fellow citizens. The statutes and decisions of the courts relating to real and personal property are brought together in a series of forty lectures and seminars. The following review and examination questions show something as to the scope of the work:

REVIEW AND EXAMINATION QUESTIONS IN FARM LAW.

1. Distinguish as clearly as possible between real and personal property. What is a fixture? Name some of the more common things on the farm that have been declared fixtures.

2. What are the essential statements in a deed? What are the characteristics of competent parties to deeds? Can an infant give a valid deed? Can a married woman convey real estate? Where must a deed be recorded?

3. What are the rights and obligations of an adjacent owner in the highway by which his land is bounded? What constitutes a legal fence? Which control in the description, metes and bounds or courses and distances?

4. Give some of the rules relating to line fences, as to location, maintenance, and liability for damage done by trespassing live stock.

5. Where the owner dies intestate, how does his farm descend?

6. Define the word contract. Who may be parties? When is the contract of an infant void? When voidable, and how and when affirmed?

7. To what are the rights of a married woman to carry on business limited? When is she liable on a promissory note signed with her husband?

8. Name the four classes of contracts that are void unless some memorandum of the terms is made by the party to be bound.

9. Where a sale of goods amounting to more than $50.00 is made, in what three ways may the bargain be made binding?

10. If you buy a horse warranted sound, and find later that he is not sound, how should you proceed against the seller? Name some of the defects that have been declared unsoundness in the horse.

11. Write a promissory note for a hundred dollars, due in three months, with interest. Write a check for the same amount.

12. What are the characteristics essential to a negotiable promissory note? In what five respects does an indorser warrant the note?

13. When a note falls due and is unpaid, what must be done to hold the previous endorsers? In what respects do the obligations of the guarantor differ from those of the endorser?

14. For what act of the hired man is the farmer liable? If the employe drives the farmer's team to the village, and on the way runs against the rig of some one else, who is responsible for the damage?

15. What are the liabilities of the farmer for the acts of his dog? for the damage done by other livestock?

16. Who is liable for damage done by a team loaned the hired man and used by him in his own business?

17. What is meant by the term bailment, and what are the obligations of a gratuitous bailee?

STUDENT LABOR.

The plan pursued last year in the management of student labor has been continued during the year just closed. In the fall term the freshmen devote these hours to the study of live stock. The sophomores aid in carrying on the general farm work, studying the operations performed on the farm at that season of the year. The list of topics studied is too long for mention here. A good deal of attention was paid to the preparation of ground for wheat, the construction and filling of silos, various methods of harvesting the corn crop, harvesting and testing sugar beets, drainage, farm accounts, farm buildings, and preliminary stock feeding.

There were fully ninety students taking the freshmen work, while the sophomore class was not large. Prof. Mumford was assisted in the live stock work by Dairy Instructor True, but notwithstanding the fact that the class was divided into two sections, each of which was in turn divided into two sub-sections, the groups of students were still too large to do each man justice. We note the impossibility of teaching stock judging acceptably in the open air or in cold weather. One of the needs of the department is a large, well lighted room in which the work in stock judging may be given. The Grade Dairy Barn, referred to later, answers this purpose but imperfectly.

The department also needs representative animals of other breeds. A description of the good and bad points of a breed of stock not represented in our own herd is of but little value to the boys. Lengthened experience in the work warrants us in urging upon you the importance of enlarging our herds and flocks in this direction.

In the winter term the freshmen report to the mechanical department for work in the wood shops and blacksmith shop. The sophomores are given their training in dairy work two hours daily for the last half of the term. The work was more satisfactory in some respects last winter than heretofore because the class was relatively small. The equipment of the dairy room is totally inadequate for handling a large class, and some preparation should be made before another season to provide appliances for the present large freshmen class.

In the spring term the freshmen were given in the two hours of student labor daily training in bee-keeping, poultry keeping and fence building, besides keeping in touch with general farm work by weekly inspection of all the growing crops on the farm and the seeding and cultivation going on there. Lectures were given on the cereals, forage crops and special crops adapted to Michigan soil and climate and on the history and characteristics of the drift soils of the State. The class was divided into sections and sub-sections in order that the groups of students reporting to the various instructors might not be inordinately large. One of the chief obstacles in the way of ideal success in this practical farm work is the ignorance of a considerable portion of the class of the most ordinary operations and facts about the farm. A part of the class is made up of boys born in the village or city and entirely unacquainted, as far as experience goes, with the methods of sowing and cultivating our most common cereals. I suggest that hereafter we be allowed to so divide the class as to bring these young men, as far as possible, into one section, that the remainder of the class may not be retarded in their progress.

The instruction in bee-keeping was given by Mr. J. M. Rankin. It was satisfactory in every way and aroused enthusiasm among students, as well as fitting them for the care of an apiary on their own farms.

TEACHING FORCE.

The sole change in the teaching force of the department during the year covered by this report has been the departure of Mr. Ernest Wittstock and the appointment of Mr. Charles H. Alvord of the class of 1895, as his successor as foreman of the farm. Mr. Wittstock was appointed foreman in the spring of 1893 and has performed the arduous and very trying duties connected with the immediate management of the College farm from that time to the date of his leaving the College, most faithfully and acceptably. The foreman has charge of the teams and the workmen upon the farm, and in the past has confined himself to the duty of carrying out the general plan of the head of the department in the matter of farm work. Beginning with the spring term of 1898 the foreman has, in addition to the management of the farm work, the further duty of aiding in the instruction of the freshmen and sophomores in farm crops and farm management generally.

As stated in my last report, the work is being specialized as far as possible. Prof. Mumford has been giving the instruction in live stock, and has had the immediate control of the stock on the farm for two years. Recognizing this fact, the board has changed his title to Assistant Professor of Animal Husbandry. Prof. A. A. Crozier, while nominally connected with the Experiment Station, only, had given in the previous year the lectures on soils and part of the instruction on farm crops. Owing to continued ill health he was obliged to be absent from the college a large part of the time in both the fall and spring terms, and finally severed his connection with the institution in June, 1898. The work with soils devolved upon Mr. Fulton, and with farm crops upon the head of the department.

COLLEGE HERD.

One important change was made in the College herd during the year. Heretofore none but full blood cattle, registered in the proper herd books, have been kept on the farm. Because of the abundance of stock feed on hand and because it was desired to know whether a profit could be made from a dairy herd at the market prices of cattle foods on the one hand and of dairy products on the other, a grade dairy herd of thirty cows was purchased in September and October, 1897. The cows were picked up in various counties in the same way that a private dairyman would purchase his cows when wanted. A new barn, forty feet wide by seventy long, was built for the use of this herd. The total cost of the herd including expenses of purchase and transportation to the College was $1134.31 for 29 cows. The plan of the barn and the items of cost are reported in Bulletin 149 of the Experiment Station. On or about the first of November next, when the year shall have been completed, a report of the behavior of the herd and of the profit and loss, with an itemized statement of both expenditures and receipts will be made in a bulletin.

The application of the tuberculin test was made in October, 1897, and repeated in March, 1898. College Rosa Bonheur, a full blood Holstein, daughter of Rosa Bonheur 5th, and Cara, a registered Red Polled heifer, responded to the test in the fall of 1897. In the spring of this year none of the registered herd responded, although one of the grade herd gave indication of the presence of tuberculosis and was slaughtered.

Excluding the animals isolated and maintained in a separate enclosure for experiments for the veterinary department there are on the farm at the date of this report 48 head of pure bred cattle, distributed among the prominent breeds as follows: Shorthorn, 13; Holstein, 19; Jersey, 8, Brown Swiss, 4; Galloway, 2; Red Polled, 2; Grades, 38.

The herd of swine includes: Duroc Jerseys, 10; Poland Chinas, 2; Chester Whites, 11.

The flock of sheep contains: Shropshires, 61; Hampshires, 11; Oxford, 4; Horned Dorset, 4; Merino, 4; Delaines, 3; Leicester, 1.

FARM CROPS.

The distribution of the crops for the season of 1897 and the yields of the various fields were reported in the annual report of the director of the experiment station, dated November 1, 1897. A similar report of the distribution and yield of the crops for 1898 will be made in the station report to be issued in November of this year.

It is well nigh impossible to adopt a regular rotation on a farm of this kind, where so many experiments must be tried in the fields and where so many points must be illustrated to students. As far as possible, the farm is devoted to growing feed for the live stock. In 1898 there are not far from sixty-three acres of corn in fields 11 and 13 and part of 6. This corn will be needed to fill the siloes and for grain. Of oats there are growing forty-five acres in Nos. 5, 8 and 15. The season is not altogether favorable for the fields used, and the crop will not be extraordinarily large. Fields 9 and 10 were devoted to hay, both clover, somewhat mixed with timothy. Some hay was also gathered from the pasture field 12, and from the low land in the west part of No. 16.

From all these sources sufficient rough fodder will be gathered to carry the teams and other stock through the winter. There will scarcely be enough corn and oats to last to the new crop next year. There is growing also several acres of oats and peas and other forage crops to carry the dairy herd through a possible drouth in August and September. These forage crops are sown in No. 6, handy to the pasture fields, 7 and 12. It is hoped that in the near future there may be silo room enough provided in which to store silage to carry the herd through the summer drouths. It is burdensome in the first place to cut and haul feed every day, and sadly interferes with the other work. In the second place, silage, being uniform and always at hand, whether the weather is pleasant or otherwise, is a much more satisfactory forage than the succession of soiling crops, no matter how wisely planned. Again, no one can forsee the character of the season and plan with accuracy for the demands of the cattle. If a surplus of silage is stored it can be utilized the succeeding winter, but a surplus of summer forage plants cannot be as certainly profitably utilized. A deficiency of soiling crops means a loss to the dairyman, and such a deficiency is liable to be brought about by an unexpectedly prolonged drouth. For these and other reasons, we hope to be able to carry over enough silage hereafter to carry the herd through the "dry spells" without the use of many soiling crops.

To supply seed of new and tested varieties several acres of wheat must be grown annually. In 1898 field 16 and most of 6 were given up to this crop.

The demands on the farm for land for other uses causes us to restrict the acres devoted to pasture to the smallest possible area. It is necessary to keep the grade herd separate from the full bloods, hence two fields have been reserved for pasture, fields 7 and 12.

IMPROVEMENTS.

The most conspicuous improvement made on the farm during the year was the erection of the new grade herd barn, located on the knoll south of the herdman's house and between it and the river. This barn is described in a bulletin, and such description need not be repeated here. It answers its purpose most admirably, is convenient, warm, well lighted, well ventilated and comfortable. New fences have been built along the lane south of the Grand Trunk railroad and the lane graded and graveled from one railroad to the other. Since the coal is now delivered on a new switch on the D. G. R. & W. R. R. it is important to have the college lane in good condition through the fall, winter and spring. The new part of the lane has therefore been well graded and graveled, and will hereafter serve its new purpose well.

New wire fences have also been built between Nos. 15 and 17, and about the experimental plots in No. 14. This work has been done altogether by students, affording them opportunity to study the different makes of wire fences and methods of construction.

THE SPECIAL COURSES.

CHEESE COURSE.

Four special courses were offered in this department during the winter. One of them, the course in cheese making, began the day after Thanksgiving and continued four weeks, closing just before Christmas. The college was extremely fortunate in securing as instructor in cheese-making Mr. E. L. Aderhold, of Neenah, Wis., whose long experience in this line had especially fitted him for the arduous duties involved in inaugurating a new course in this State. Equipment could be provided but for twenty students, although many more than this number applied for admission to the course. Among the men in attendance were many old cheese makers. One had managed a factory for eleven years, another for nine years, another for seven and several for more than three. Interest in the work increased from the beginning to the end of the course, and all the students went away gratified by the skill and knowledge they had acquired at the college. There was used in this cheese course 30,531 pounds of milk from which were made 2,928 pounds of cheese. The cheese was cured in a room fitted up for the purpose in the basement of the Agricultural Laboratory. It was found that a very even temperature could be maintained and that the air could be kept at the desired saturation point. The records made by the recording thermometer show a variation of less than five degrees from the normal selected, which was 65 degrees. The cheese when ripened proved to be of excellent quality.

CREAMERY COURSE.

During the fall of 1897 steam pipes were laid to connect the laboratory with the central heating plant of the college. This improvement obviated the necessity of maintaining a separate boiler and dispensed as well with the coal storage room in the southwest corner of the basement. The partitions were removed between the boiler room and the space heretofore used for instruction in butter making, affording a large and fairly well lighted room, which could be devoted to the separators, churns, butter workers and vats needed in the instruction in a creamery course. During the late fall and early winter this room was equipped for this purpose, the use of the separators being donated by the manufacturers. The college is indebted to the De Laval Separator Co., 74 Cortlandt St., New York; P. M. Sharpless, West Chester, Pa.; A. H. Reid, Philadelphia, Pa.; The Vermont Farm Machine Co., Bellows Falls, Vt., for the loan of separators; to the Star Milk Cooler Co., for the use of a milk cooler, and to F. B. Fargo, of Lake Mills, Wis., for the use of a combined churn and worker.

There were twenty-seven students in attendance upon this course. Many of these young men had had no experience either in the management of creameries or working in them. For such members of the class the work was necessarily elementary, and when they left the college they were not prepared to take charge of factories. This is unfortunate, and the instruction could be made much more systematic and much more beneficial to the students and to the State if hereafter admittance to the creamery course could be limited to such persons as have had some practical experience gained by working in a creamery.

The increase in the number of factories in the spring of 1898 has supplied an opportunity for such of these young men as had previous experience in practical work to put the training they received at the college into immediate use. Not a single member of the class who thus combined this college course with previous experience is without a place at a satisfactory salary. So great indeed has been the demand for men that many of the students who came without previous experience are now managing, with good success, public creameries.

It is in many respects to be regretted that a model public creamery cannot be maintained at the college the year round. It would relieve the pressure of students for place in the one possible special course in creamery work by giving opportunity to take the instruction at any time of year they might find it possible to come. It would allow us to train men more thoroughly than we are now able to do with our limited equipment and still more limited milk supply. Finally by arranging with a number of farmers near the college it would make it easy for us to find the requisite milk supply for the special course in the winter, without trespassing on the kindness of the Condensed Milk Company. Until we have a suitable building to accommodate a larger class and a fuller equipment wherewith to carry on the instruction to a more advanced point, I recommend that hereafter we receive those young men alone to the creamery course who have had some experience in a factory.

It seems but just, in this connection, to refer to the very satisfactory manner in which the instruction in what might be termed the more scientific subjects in connection with the creamery course has been given. Professor Frank Kedzie supervised the instruction in dairy chemistry The subject was made interesting and very valuable. It is necessarily technical and hard to understand to a young man without previous training in the art of observing, yet the matter was presented in a form so simple and in a manner so plain that the young creamery men saw its importance and readily comprehended its significance to them.

The work in veterinary anatomy and medicine was also very acceptable and valuable to the students. They acquired a knowledge of the anatomy of the digestive and reproductive organs of the cow and something as to the treatment of the most common diseases. It would be hard to exaggerate the value of this knowledge to the patrons of the creameries over which the young men will preside. Dr. G. A. Waterman gave the instructions along veterinary lines.

The subject of creamery mechanics was given a prominent place in the course because every manager of a creamery has under his constant care a boiler and engine and no small amount of piping. The steam plant is usually not the best in construction and requires a good deal of skill to keep in repair. Judgment in buying lubricating oil, in selecting and adjusting belts and other mechanical appliances, and in buying and using fuel is of prime importance in keeping down the running expenses of the creamery. This part of the course was in the hands of Mr. G. N. Eastman, a graduate of this college in the mechanical course, who succeeded in interesting the class in the work and making it clear and valuable to them.

The intimate relation of dairy bacteriology to practical creamery work is apparent. As thorough a course as possible in the short time allowed was given the class in this subject by Mr. C. E. Marshall, who made the technical subject plain and practically useful. This phase of the course was much appreciated by the class and will prevent many mistakes and provide a reasonable instead of empirical basis for the methods of handling cream which they will adopt.

HOME DAIRY COURSE.

This course, like the one in creamery management, began January 3, 1898, and continued six weeks. Seven young men attended. Mr. P. H. Davis, of St. Johns, assisted Mr. True in the instruction in practical butter making.

Special stress was laid in this course as well upon the selection and feeding of the dairy herd as upon the art of handling the milk and cream after they had left the dairy barn. I am glad to report that the young men who took the course came from farms which they owned or in the management of which they were interested. This fact made them enthusiastic, painstaking and thorough in their work. The course, however, probably because it does not lead directly to a lucrative position, does not draw as many students interested along dairy lines as does the creamery course.

In addition to the list of scientific subjects which form part of the creamery course a series of fifteen lectures and exercises on forage plants was added for the farm dairy students. Dr. Beal has this subject in charge and aroused the interest of the students in it.

SPECIAL COURSE IN LIVE STOCK HUSBANDRY, WINTER OF 1897.

After careful consideration it was thought that there was a place for a special course in Live Stock Husbandry. Stock raisers and farmers who were consulted gave every encouragement. As a result a course of lectures was outlined with especial reference to their bearing on practical stock breeding and feeding.

Fifteen young men took advantage of this course and if the earnest work and enthusiasm manifested by these young men can be taken as a guide as to their appreciation of the value of the course, we have reason to feel encouraged to continue this special course in Live Stock Husbandry, the outline of which was more or less tentative during the first year.

REPORT OF THE DEPARTMENT OF HORTICULTURE AND LANDSCAPE GARDENING.

To the President:

Sir—I herewith submit a report of the Horticultural Department for the past year.

The classroom instruction has been along similar lines to those followed in previous years, but, owing to the rearrangement of the course, the topics were pursued in a different order.

During the winter term the juniors received instruction in floriculture for the first six weeks, and the last half of the term was occupied with lectures in pomology. During the spring term the sophomore and junior classes were instructed for the first six weeks in vegetable gardening, and the remainder of the term was given up to landscape gardening.

In floriculture the subject was presented so as to include both the culture of flowers in the home and the growing of the leading crops of the commercial florist. In connection with this classroom instruction students were occupied each afternoon in practical work in the greenhouse and forcing houses. They thus learned to make cuttings of different kinds of plants, the care of propagating beds, potting and repotting plants as well as the sowing of seeds, pricking out and caring for seedlings in pots and boxes, and the general handling of flowers and vegetable plants under glass. Each student also gave a week or more to the study of greenhouse construction, and was required to draw complete plans and make estimates upon the cost of the houses, including the heating plants.

The instruction in vegetable gardening included the planting and growing of the ordinary garden vegetables, and, in connection with this, the selection and preparation of the soil, preparation and use of manure and fertilizers, the construction of hot beds and cold frames, as fell as drainage and irrigation for the vegetable gargen, were considered.

In landscape gardening, the grading and preparation of the lawn, the arrangement and construction of walks and drives, and the selection of trees, shrubs and flowers, and their arrangement in groups and beds received attention.

During the spring term the practical work of the junior class consisted of the routine work in the greenhouses and the fruit and vegetable gardens, as well as in the orchards and on the grounds. In this way instruction in grafting, pruning and transplanting and in the care of orchard trees was given, as well as the growing, transplanting and care of nursery stock.

In the vegetable garden the ground was prepared and the seeds were sown, or the plants were transplanted from the forcing house, while on the grounds the shrubbery was pruned, new groups and beds were made and filled with plants and shrubs from the greenhouses.

The juniors and sophomores were each required to prepare an essay upon some topic relating to horticulture, which was also counted as a part of the work in English, and those taking landscape gardening drew plans for the laying out of residence grounds of various sizes, as well as school grounds, cemeteries and parks.

In the fall term the seniors, to complete their work in pomology begun in the previous year, gave particular attention to the fruits in the orchards and gardens, and a study was made of the varieties that could be secured during the fall months, either from the college orchards or from fairs, and attention was also paid to the characteristics of the various species of fruit trees and plants in cultivation, and careful descriptions and drawings were made of the twigs, buds and foliage, as well as of the fruit.

SPECIAL SIX WEEKS COURSES.

During the first half of the winter term, arrangements were made for instruction in fruit culture for a period of six weeks to special students in that topic. The lectures were designed to cover, so far as was possible in that time, the growing of trees and other fruit plants in the nursery, their pruning and general care in the orchards. Considerable attention was given to the use of fertilizers, cultivation, the spraying of the trees for fungous diseases, and the gathering and marketing of the crop. In addition to this classroom instruction, they had practical work in pruning and grafting, and a study was made of some of the leading American varieties from wax and natural specimens. In addition to the work in fruit culture proper, they spent one or more hours each day in the department of chemistry, botany and entomology. In this way, young men who had not the time to take a full college course, or who were particularly interested in fruit culture, were enabled to secure in a comparatively short time a large amount of useful information which would aid them in their work.

STUDENT LABOR.

As will be seen from the foregoing, much of the time of the students assigned to this department for their regular afternoon work, was devoted to laboratory or educational work, but as the amount that could be furnished did not occupy the time, they were employed upon the routine labor of the department, which added to their proficiency.

In addition to the required labor, quite a number of the students gave additional time to the practical horticultural work, and a large number whose regular work was upon the farm or in the shops worked in this department during their spare hours in the school week and upon Saturday, thus obtaining a knowledge of horticultural methods, as well as assisting in paying their college bills. In addition to the work performed by the young men, several of the young women aided in the office work in keeping books and records and in correspondence, while others helped in the work of the greenhouses and forcing houses.

VEGETABLE AND FRUIT GARDEN.

While most crops grown in the fruit and vegetable gardens were primarily experimental, they served to illustrate the planting and handling of the various small fruits and vegetables, and the surplus products were harvested and sold to boarding clubs and members of the faculty. Except that some of the vegetables upon low grounds were seriously injured by the heavy rains of August, 1897, the crops of that year were in the main satisfactory, and the season of 1898 up to the present time has been very favorable for the growth of nearly all of the garden crops. The strawberries made a good showing up to the time picking began, but the weather for a number of days was very hot, so that the ripening period was hastened and the picking season shortened. The other small fruits are in a promising condition. The work of gathering, selling and delivering of fruits and vegetables has been almost entirely performed by the students.

THE ORCHARDS.

As with the vegetable and fruit gardens, planting in the orchards for the past ten years has been largely of new varieties whose value we wish to test, so that the products have been much less satisfactory than would have been the case had an equal area been devoted to standard sorts. Owing to the general failure of the apple crop in 1897, the amount of this fruit secured was comparatively small, being less than two hundred bushels of marketable fruit. The pears gave an excellent crop upon the older trees in 1897, and promise to do even better this year. The peach trees were so injured during the winter of 1896-7, that the fruit buds were entirely destroyed and no fruit was obtained the following summer. In the spring of 1897 the trees were shortened in, and a new growth started from the lower branches. The trees are now in excellent condition, and most of them promise a fair crop this fall. When the leaves appeared last spring they were attacked by "curl leaf," but this was controlled by spraying, at an expense of one to two cents per tree.

GROUNDS.

For a number of years the lawns have been severely injured by the lack of water owing to the drouth, and the fact that the college water system is inadequate to furnish the amount required for watering them, except about the residences and a few buildings, but except for a few days the rainfall in 1897 was such as to keep them in a fresh and growing condition, and the same is true to the present time this year.

In the spring, numerous additions were made to the shrubbery groups west of the President's house and about the Library, and Horticultural Laboratory, as well as in other places.

In the fall of 1897, the street car line was extended from the west entrance to a point between Station Terrace and the residence of the professor of English Literature, and the department teams did the grading for the track. The entrance of the line at this point made it necessary to open a new drive for carriages, and this was constructed along the east side of the railway, and made considerable grading necessary.

Last spring an artificial stone walk was constructed from the railway station to a point near College Hall, for the use of visitors and others wishing to go to and from the Library and buildings in the vicinity.

In accordance with instructions from you, the grounds about the Harrison house were graded, walks and drives were laid out, and a large number of shade trees, evergreens and shrubs were planted, and the lawn has been cared for by this department.

GREENHOUSES.

As in previous years, the greenhouses have been one of the principal places of attraction for visitors, and the plants have been in their usual flourishing condition; besides serving the purpose of instruction in horticulture and botany, they have furnished plants for the grounds and plants and flowers for decorations at public functions, both at the college and the State Capitol. During the session of the legislature a supply of flowers was sent down twice a week for the decoration of the desks of the Speaker of the House and the President of the Senate. From time to time various species have been added to the collection of plants and will soon develop into handsome specimens.

ASSISTANTS.

Mr. Thomas Gunson has now entered upon his eighth year here, seven of which he has been in charge of the college greenhouses. The details of the work, as well as the direction of the work of the students in practical floriculture, have been left with him, and he has performed his duties in an able and conscientious manner. He has been assisted in the care of the houses by George L. Perry, a former student in the college.

In April, the foreman of the orchard and gardens, Thomas Durkin, having resigned, the position was filled by the appointment of Charles A. Wood of Napoleon, who has since that time had charge of the work of the men and teams.

The assistants in the horticultural department, Messrs. Gladden and Dean, have, in connection with their regular work, had charge of much of the labor of the students in the vegetable and fruit gardens, and in my absence have taken charge of the classes.

SOCIETIES AND FAIRS.

In previous years this department has always made exhibits of its products at the State fair, but in accordance with the vote of the Board of Agriculture, no exhibit was made in 1897. The department, however, was represented, and Mr. Dean and myself acted as judges of the fruits upon exhibition.

During the year I have attended the meetings of the State Horticultural Society at Ithaca, Hudson and Muskegon, and at each have presented papers. At Ithaca the subject was "Cold Storage," while "Lawn Planting" was considered at Hudson and "Spraying" at Muskegon. As time permitted, visits have been made to a number of local horticultural societies.

In September, 1897, the American Pomological Society met at Columbus, Ohio. I attended as a delegate from the State Horticultural Society. While at Columbus I visited the State University and the State Fair which was held at this time. In December I attended the meeting of the Ontario Fruit Growers' Association at Waterloo, Ontario, and there met many leading horticulturists of Ontario, and several of the officials of the Ottawa Experiment Station; after the close of the meeting I visited the agricultural college at Guelph. During the Christmas holidays I received and accepted an invitation to attend a meeting of the South Essex Horticultural Society at Kingsville, Ontario.

FARMERS' INSTITUTES.

Owing to the change in the arrangement of the college terms, it became easier to give time to institute work during the summer than in the winter, as had previously been the case, and arrangements were made for a number of summer institutes.

The first was held at Hudson and Adrian in connection with the local horticultural societies, and in July others were held at Traverse City, Chief and Frankfort under the auspices of the institute societies of Grand Traverse, Manistee and Benzie counties. In August, another series was held in the southern tier of counties, at Scofield, Adrian and Hudson, in connection with the county horticultural society. In February, the Long Fruit Institute was held at Grand Rapids. It lasted four days, and was well attended by fruit growers of Kent county and by others from the surrounding counties. The topics considered by myself were "Small Fruit Growing" and "The Diseases of Fruits." Roland Morrill, president of the State Horticultural Society, gave two talks each day relating to peach and plum culture, while Prof. Barrows discussed the nature of some of the more troublesome insects and gave recipes for their destruction. I also attended the session of the round-up at the college.

In June, 1898, summer institutes were held at Ida, Monroe county, and Adrian and Hudson, Lenawee county. As in 1897, the meeting at Adrian was under the auspices of the Lenawee horticultural society, that at Hudson of the Lenawee and Hillsdale horticultural society, and at Ida the Monroe county institute society.

Respectfully submitted,

L. R. TAFT.

Professor of Horticulture and Landscape Gardening.

Agricultural College, Michigan, June 30, 1898.

REPORT OF THE MECHANICAL DEPARTMENT.

To the President:

Sir—I have the honor of submitting the following report of work done in the Mechanical department during the year ending June 30, 1898.

The work in the class rooms, drawing rooms, etc., has been conducted as follows:

FALL TERM.

Seniors—Thermodynamics and Valve Gears by Prof. Weil. Experimental Laboratory by Prof. Weil and Mr. Smith. Steam Engine Design and Graphical Statistics of Mechanism by Mr. Westcott. Shop Practice by Mr. Leonard.

Juniors.—Elementary Kinematics by Mr. Westcott. Machine Design by Mr. Smith. Metallurgy by Prof. Weil. Shop Practice by Mr. Leonard.

Sophomores.—Shop Methods by Mr. Leonard. Shop Practice by Messrs. Leonard, Hoyt and Theadore.

Freshmen.—Shop Practice by Messrs. Hoyt and Newman.

WINTER TERM.

Seniors.—Advanced Kinematics by Prof. Weil. Steam Engineering Laboratory by Prof. Weil and Mr. Smith. Advanced Machine Design by Mr. Leonard.

Juniors.—Machine Design, Steam Engine Design and Valve Gears by Mr. Westcott. Boilers by Prof. Weil. Shop Practice by Mr. Leonard.

Sophomores.—Elements of Machine Design by Mr. Smith. Shop Practice by Messrs. Leonard, Theadore and Baker.

Freshmen.—Shop Practice by Messrs. Bradford, Westcott and Newman.

SPRING TERM.

Seniors.—Engineering Practice, Original Design and Thesis Work by Prof. Weil.

Juniors.—Strength of Materials and Testing Materials of Engineering by Mr. Westcott. Shop Practice by Mr. Leonard.

Sophomores.—Elements of Machine Design and Elements of Steam Engine by Mr. Smith. Shop Practice by Messrs. Leonard, Theadore and Baker.

Freshmen.—Shop Practice by Messrs. Bradford, Newman and Baker.

No important change was made during the year in the regular studies and exercises, and but few changes were made in the apportionment of work among the instructors.

During the past year we have completed, in our shops, a ten-inch wood lathe, and have made a number of small tools, and appliances—such as collar and plug gauges, boring bars, angle plates, parallel blocks, etc.; also a large number of rests (8) and face plates(25) were constructed for the wood lathes, and spindles of all wood lathes were arranged for interchangeable plates; a conveniently arranged blackboard was constructed for use in the wood shop. During the summer of 1897, our instructors, assisted by a number of students, were employed, for the greater part of the vacation, in making repairs and improvements in the laboratory; during this period considerable work was done upon the details of a milling machine—designed in our drawing rooms—now being built in our shops.

We continue to consider it advisable to give instruction in the shops through the aid, mainly, of progressive exercises, and not to attempt much in the way of building complete machines.

An interesting addition to our equipment is a file of cards illustrating machine tools of various kinds; this file was arranged, chiefly, through the assistance of Mr. Westcott.

At the present time our shop instructors and a force of students are engaged in making repairs, etc., in the shops and experimental room, and the work will continue for a considerable part of the vacation.

The expenditure in this department, during the past year, for equipment, has been relatively small; a number of small tools have been purchased for the shops, for general use, also a few special articles, including section liner, steel tape, slide rule, micrometer depth gauge, gear tooth caliper, lathe test indicator, etc. It has been necessary, however, because of the increased attendance, to devote a large part of the apportionment, for the year, to the purchase of materials (stock) for use in the shops.

The alterations and improvements in the experimental room, mentioned in the report for '96-'97, have been completed and afford the department much satisfaction.

Mr. C. E. Hoyt, foreman of the wood shop and foundry, resigned January 1, 1898, to accept a position as foreman of the foundry of the Lewis Institute at Chicago. Mr. Hoyt is an instructor of marked ability, and his departure caused much regret, both among students and instructors. Mr. W. R. Bradford was engaged as foreman of the wood shop at the beginning of the winter term of '97-'98, and he has performed the duties pertaining to the position in a very satisfactory manner. Mr. E. C. Baker, who was connected for a number of years with the Lansing Engine and Boiler Works, has been engaged as foreman in the foundry. Mr. Baker entered upon his duties during the winter term, and he has proved to be a valuable addition to our corps of instructors, and the employment of separate foremen in the wood shop and foundry has resulted very beneficially for the work of the department. Mr. Chase Newman, who has been department clerk for several years, has rendered efficient service as assistant in the wood shop during the past year. Mr. Newman has also acted as instructor in the Drawing department. During the winter term Mr. Westcott rendered valuable service by giving instruction in wood turning to agricultural students. It is hardly necessary to note that the large increase in attendance occasioned the demand for additional assistance in the shops.

During the winter term of '97-'98 Mr. Westcott, Mr. Leonard and the writer attended a mechanics' institute at Detroit; two days were devoted to this work. During the fall of '97 much of the time of the professor in charge of the department was given to the work of laying underground steam pipes and piping buildings for steam.

Respectfully submitted,
CHAS. L. WEIL,
Professor of Mechanical Engineering.

Agricultural College, Michigan, June 30, 1898.

REPORT OF THE CHEMICAL DEPARTMENT.

President Snyder:

We herewith submit the annual report of the work in the Chemical department for the year ending June 30, 1898:

The work in the department has been characterized by great activity on the part of instructors and students alike. The number of students in the agricultural, mechanical and woman's course has been constantly increasing, and many of the classes have been divided into two sections in order to find adequate room, especially in laboratory practice. While the rooms have been crowded, the enthusiasm of the students has not diminished.

With a prospective still greater increase in the size of classes in chemistry, the question arises whether an increase in room for laboratory work will not soon be a necessity. The cry in days of old, "The place is too strait for me; give place to me that I may dwell," is the natural expression of growth and prosperity, and an occasion for congratulation rather than dismay at increased expenditure. The room was ample when only the Agricultural course was organized. With the large addition brought in by the Mechanical course, and the further increase by organizing the Woman's course, and the large influx only waiting for adequate dormitory accommodations, the increase in space for the chemical laboratory will become a pressing demand in the early future.

Many years ago Gov. Bagley said he would never be satisfied with the condition of the Michigan Agricultural College till its freshman class numbered 100 students. We then held our breath in astonishment at the audacious suggestion; but now that the freshman class has passed the 200 mark and is rapidly approaching 300, we begin to grasp the capacity and the needs of this young giant in the educational family of the Peninsular State.

CLASS ROOM INSTRUCTION AND LABORATORY WORK.

The instruction in chemistry and work in the laboratory during the year were along the same lines as were shown in our last report, but many of the classes had to be divided on account of their size, and the work for the teacher largely increased.

In addition to the ordinary work of the department, lectures and laboratory work were offered to the students in the special classes provided for short course students. A course of lectures on Agricultural Chemistry was given by the senior professor, and a course of instruction by Mr. Munson, assistant in chemistry in the Experiment Station, on the Chemistry of Milk.

SPECIAL INVESTIGATION FOR THE PUBLIC.

A large number of specimens of marls, mucks and unusual soil formations have been examined and analyzed in response to individual applications, and letters in reply have been written. Many specimens of materials for the preservation of milk, fruit and other food materials have been tested, and opinions given on the subject. The letters of information and advice on various subjects have been too numerous to recount and to various to classify.

FARMERS' INSTITUTES.

The work in classes and laboratories was too exacting to permit our attendance on the farmers' institutes last winter, but we attended the round-up at the College in February and gave an address on Beet Sugar.

R. C. KEDZIE,
Prof. Chemistry.
F. S. KEDZIE,
Adjunct Prof. Chemistry.

REPORT OF THE DEPARTMENT OF VETERINARY SCIENCE.

To the President:

Sir—I have the honor to submit the following report of the work done in the Veterinary department during the year 1897-98:

In the fall of 1897 those seniors electing the work, began the study of the anatomy of the domesticated animals. This work required a greater part of the fall term, at the close of which two weeks were spent in dissecting an old horse destroyed for that purpose. This work in the dissecting room brought before the students in a clearer manner the complicated mechanism of the animal economy. While the horse is taken as the type in our veterinary work, the other domesticated animals receive their share of attention.

During the winter and spring terms, the diseases to which our domesticated animals are subject were taken up in order and discussed as to their causes, both predisposing and exciting; the symptoms by whch the diseases are recognized and their treatment, both hygienic and medicinal.

The class had the privilege of witnessing a small amount of practical work in the way of clinics. It is hoped that this phase of the work may grow in future years.

The class also received from Prof. Marshall twenty lectures upon bacteriology as relating to animal diseases.

During the first half of the winter term, the sophomore class received thirty lectures upon veterinary subjects. These were confined more especially to the anatomy and diseases of the digestive organs of the horse and cow; parturition and the diseases incident thereto; lamenesses, their causes and treatment.

During this same time the special course students received about the same lectures as were given to the sophomores.

I have, during the year, attended the sick animals belonging to the different departments and have done such experiment station work as requested by the director.

People in the vicinity, bringing animals to the College, have received veterinary advice free, the object being the working up of a larger clinic for the benefit of the students.

Respectfully submitted,
GEORGE A. WATERMAN,
Professor of Veterinary Science.

Agricultural College, October 1, 1898.

REPORT OF THE DEPARTMENT OF MATHEMATICS AND CIVIL ENGINEERING.

To the President:

Sir—The aggregate enrollment in all classes of this department has increased from 513 in the year 1896-97 to 902 this year, a gain of more than 75 per cent. This statement indicates pretty well how busy a year this has been, and it is believed that it has been a year of fairly efficient effort and good results as well. In several instances class divisions have been too large to be taught to the best advantage, and results have no doubt suffered in some small degree. It was found quite impossible to care for all the divisions in freshman mathematics without additional teaching force, and Miss Lilian Wheeler was engaged to assist in the work. To her were assigned two divisions daily, each term of the year.

During the summer of '97, Instructor C. C. Pashby resigned his position with this department, to take up work in practical engineering. Mr. Pashby had served the College faithfully and well since the fall of 1894. The vacancy caused by his resignation was filled by the appointment of Mr. W. O. Beal, a graduate of Earlham and Haverford colleges.

INSTRUCTION.

During the three terms covered by this report we have met classes as shown in the following statement, which also indicates the instructor in charge of each class and the number of students enrolled in the department each term:

Fall term, 1897.—Seniors, one class in graphic statics, Professor Vedder; and one class in civil engineering with afternoon field practice, Professor Vedder. Juniors, one class in integral calculus, Assistant Professor Babcock; and one class in surveying, with afternoon field practice, Professor Vedder. Sophomores, one class in trigonometry, Professor Vedder; and one class in solid geometry, Assistant Professor Babcock. Freshmen, six classes in algebra, two for mechanical students, commencing with the subject of quadratics, in charge of Assistant Professor Babcock and Mr. Beal; and four for agricultural students, beginning the study of algebra, two classes being in charge of Mr. Beal and two in charge of Miss Wheeler. Total enrollment for the fall term in all regular classes, 310.

Winter term, 1898.—Seniors, one class in engineering methods, to which was presented a course of lectures on the simpler and more useful principles of land drainage, sewerage, house drainage, plumbing, roads and bridges, Professor Vedder. Juniors, one class in mechanics of engineering, Professor Vedder. Sophomores, one class in analytic geometry, Assistant Professor Babcock. Freshmen, two classes in algebra, second term's work for mechanical students, Assistant Professor Babcock and Mr. Beal; four classes in algebra, second term's work for agricultural students, two classes each in charge of Mr. Beal and Miss Wheeler; and two classes in plane geometry, Assistant Professor Babcock and Mr. Beal. Total enrollment for winter term, 324.

Spring term, 1898.—Seniors, one class in civil engineering, with afternoon field practice, Professor Vedder. Juniors, one class in mechanics of engineering, Professor Vedder. Sophomores, one class in differential calculus, Assistant Professor Babcock; one class in plane trigonometry, Professor Vedder; and one class in surveying, with afternoon field practice, Professor Vedder and Mr. Beal. Freshmen, four classes in plane geometry, of which Assistant Professor Babcock taught one, Mr. Beal one, and Miss Wheeler two; and two classes in solid geometry, Assistant Professor Babcock and Mr. Beal. Total enrollment for spring term, 268.

In addition to the regular class work as above reported, we have given special instruction in bridge analysis and detail drawing, sewerage, stone arches and surveying, and have given general oversight to the preparation of several student theses.

We have read and marked 158 entrance examination papers, 49 special examinations for advanced standings, and 66 examinations for making up back work.

Other questions concerning the work of instruction will be answered by the following table:

Class work of the Department of Mathematics and Civil Engineering for the college year 1897–98.

Class.	Subject.	Term.	Number of divisions.	Number of hours per week for each division.	Total number of hours per week for the class.	Number of students enrolled.
Freshmen	Algebra	Fall	6	5	30	195
Freshmen	Algebra	Winter	6	5	30	209
Freshmen	Geometry	Winter	2	5	10	65
Freshmen	Geometry	Spring	6	5	30	182
Sophomores	Geometry	Fall	1	5	5	38
Sophomores	Trigonometry	Fall	1	5	5	37
Sophomores	Analytic geometry	Winter	1	5	5	33
Sophomores	Plane Trigonometry	Spring	1	3	3	22
Sophomores	Surveying	Spring	1	4	4	21
Sophomores	Differential calculus	Spring	1	5	5	28
Juniors	Surveying	Fall	1	4	4	16
Juniors	Integral calculus	Fall	1	5	5	13
Juniors	Mechanics	Winter	1	5	5	12
Juniors	Mechanics	Spring	1	5	5	10
Seniors	Civil engineering	Fall	1	10	10	8
Seniors	Graphic statics	Fall	1	3	3	3
Seniors	Agr'l engineering	Winter	1	5	5	5
Seniors	Civil engineering	Spring	1	7	7	5
Totals			34		171	902

EQUIPMENT.

Almost nothing has been added to our permanent equipment of instruments and working tools. The small sum of $37.34 has been expended for office blanks, repairs to instruments and in the purchase of a book on plumbing and heating.

The inventory for this year, of property belonging to this department, including instrumental equipment, observatory, office and class room furniture, shows an aggregate value on June 30 of $3,974.06, against $3,969.98 for last year.

PRACTICAL ENGINEERING, ETC.

We have made surveys for the extension of water pipe to the new dairy barn, for a new sewer connection to Abbot Hall, for a steam line to the Agricultural Laboratory, for a sewer lateral to the greenhouse and for an extension of the water pipe line to the Delta. A great deal of time and labor has been spent in establishing the corners of the Delta and rectifying its boundaries. Its area has been divided into lots for sale and platted in accordance with legal requirements. Many other surveys of minor importance have called for a considerable total in time and energy. A new map of the campus, of considerable accuracy and detail, has been prepared, from which reduced plates were made for printing in the catalogue, or wherever a college directory is needed.

During most of the year there has been observable, at least, the average degree of studious endeavor on the part of the students in our classes. The spring term only was unsatisfactory in this respect. The attention of the students was distracted in that term by a number of disturbing influences. Among these may be mentioned the excitement caused by the breaking out of the Spanish war, and an unusual number of holidays, which shortened the working time of a term already very short.

Respectfully submitted,
H. K. VEDDER,
Professor of Mathematics and Civil Engineering.

Agricultural College, Michigan, June 30, 1898.

REPORT OF THE LIBRARIAN.

To the President:

Sir—I have the honor to present the following report on the library for the year ending June 30, 1898.

During the year 743 bound volumes have been added, 377 of which were purchased, 105 donated and 261 from the bindery. To the following we are indebted for bound volumes:

Amer. Hereford Record, v. 16, 17, 18.
Amer. Duroc-Jersey Record, v. 6, 7.
Amer. Southdown Record, v. 5.
Amer. Shropshire Record, v. 12.
Butterfield, K. L. Mich.
Beal, Dr. W. J., Manual of Prac.
Dureau, G., "Visit to the Klein-Wangleben Beet Sugar Factory."
Farrington & Woll, "Testing Milk."
Hampshire Down Flock Book, v. 4.
Hutchinson, F., "Hew S. Wales."
Holstein-Fresian Herd Book, v. 14, 15.
Kansas Hort. Society, Trans. 1896.
Michigan—
Supt. Public Instruction, Report 1896.
Labor Bureau, 1.
State B'd Health, 2.
State B'd Agriculture, 1.
Sec'y of State, 2.
Mich. Merino Sheep Breeders' Ass'n Register, v. 3.
Natural History Society, Mich. Agr'l College, 49 vols.
National Duroc-Jersey Record, v. 2, 3.
Pepper, W., and others, "The Veterinary Profession."
Rea, G. B., "Facts and Fakes about Cuba."
Red Polled Herd Book, v. 8, 9.
Shropshire Flock Book, v. 15, 16.
Smithsonian Institution, 3.
Union Literary Society, "The Union Lit."
U. S. Reports—
Dept. of Agriculture Year Book, 1896, 1897.
Animal Industry Report, 1895-96.
Labor Bureau. 2.
Bureau of Education, 3.
War Dept. 7.

UNBOUND DONATIONS.

Australia, 18.
Amer. Museum Nat. History, Bulletin, v. 9.
Aitken, Hon. D. D., "The Tariff."
Amer. Soc. Mech. Engineers' Trans. 1896-7.
Amer. Soc. Civil. Engineers, Trans., v. 37.
Allen, Hon. Wm. V., 1.
L'Academie Hongroise des Sciences, 1.
Bussey Institution Bulletin, v. 2, pt. 6.
British Columbia, Dept. of Agri., 1.
Butterfield, K. L., Reports of Institutes, 3.
Beal, Dr. W. J., Rep'ts Mich. State Grange, 14.
Queensland Agr'l J'l, 2.
Brazil, 8.
Budapest, 4.
Buell, J. (Miss), Secy. Mich. State Grange, 9.
Canada, 5.
Columbia Univ. Bulletins, nos. 18, 19.
Cannon, Hon. F. J., 1.
Cuba, New Constitutional Laws, 1897.
Cole, L. J., Mich. Ornith. Club Bulletins, 1, 2.
Cincinnati Soc. Nat. Hist. J'l., v. 19, No. 3.
Cirencester (Eng.) Agr'l Students' Gazette.
California Acad. of Sciences, 2.
Elisha Mitchell Scientific Soc., 2.
Essex Institute, 4.
Field Columbian Museum, 2.
France Bulletins Ministere de l'Agriculture, 6.
France Bulletins des Seances de la Societe Nat. d'Agri., 9.
Hamilton Ass'n J'l and Proc., 1896-7.
Heath, Milligan & Co., Hist. of Paints, Pigments and Colors.
Jamaica, 40.
Kansas Acad. of Science, Hist. of Organization.
Michigan Reports, Dairy and Food Bulletins, 12 nos.
Vital Statistics, 6 nos.
Mich. Engineers' Annual, 1898.
Mich. Polit. Sci. Ass'n Publications, 4.

- Maine State Pomological Soc. Trans. 1896.
- Mass. Horticultural Society, 1897, pt. 1.
- Metz. Memoires de l'Académie de Metz, 1896.
- Mexico, 11.
- McCleary, Hon. J. T., 1.
- Nova Scotia Institute of Science, Trans., v. 9, N. 3.
- Patten, Hon. J., 1.
- Pasadena Acad. of Science, 1.
- Rothamsted, England, Memoranda of Experiments, etc., 3.
- Sargent, C. S., Report on "Forest Policy," 1897.
- Smiley, A. K., Report on "Internal Arbitration," 1897.
- Strang, Mr., "Lay Sermons," n. 1.
- Squibb, E. R., E. H. and C. F., Ephemeris of Materia Medica, v. 5, n. 1.
- Smithsonian Institution, 3.
- Trinidad Botanic 1.
- Tufts College, 1.
- Tenn. B'd of Health Bulletins.
- Turner, Hon. H. G., 1.
- Thurston, L. A., 1
- U. S. Reports—
    - Labor Bureau Bulletins.
    - Foreign Commerce Consular Reports, 8.
    - Treas. Dept., 16.
    - Education, Bureau of, 1.
    - Interior, 3.
    - Patent Office Rept., 1896.
    - War Dept., 1.
    - Agriculture Bulletins of U. S. Weather Bureau.
    - Navy, 1.
    - Civil Service, 1.

In the reading room are the following publications:

FOREIGN.

- Analyst.
- Agricultural Gazette.
- Annals of Botany.
- Annales de l'Institut de Pasteur.
- Blackwood's Magazine.
- Biedermann's Centralblatt.
- Botanisches Centralblatt.
- Chemical News.
- Centralblatt Bakterologie, Erste Abteilung.
- Centralblatt Bakterologie, Zweite Abteilung.
- Electrician.
- Engineering.
- Edinburgh Review.
- Entomologist.
- Entomologist's Monthly Magazine.
- Garden.
- Gardners' Chronicle.
- Hygiene Rundschau.
- Journal Royal Agricultural Society.
    - Horticulture.
- Journal Antomy and Physiology.
    - Chemical Society.
    - Society of Chemical Industry.
    - Royal Microscopical Society.
- Kew Bulletins.
- Lancet.
- La Laiterie.
- Die Landwirtschaftliche Jahrbücher.
- Die Landwirtschaftlichen Versuchs-Stationen.
- Magazine of Art.
- Milch Zeitung.
- Macmillan.
- Revue Horticole.
- Revue General de Botanique.
- Veterinarian.
- Veterinary J'l.
- Westminster Review.
- Zeitzschraft für Hygiene.

AMERICAN.

- American Entomological Society.
    - Florist.
    - Sheepbreeder.
    - Agriculturist.
    - Cheesemaker.
    - Cultivator.
    - Gardening.
    - Chemical Journal.
    - Veterinary Review.
    - J'l. of Science.
    - Microsc. J'l.
    - Naturalist.
    - Machinist.
    - Engineer, Car builder, and R. R. Journal.
    - Kitchen Magazine.
- Annals of Amer. Acad. of Polit. Science.
- Art Amateur.
- Atlantic.
- Annals of Mathematics.
- Auk. The.
- Boston Soc. of Nat. History.
- Breeders' Gazette.
- Botanical Gazette.
- Bulletin Torrey Botanical Club.
- Chicago Inter-Ocean, daily.
- Century.
- Country Gentleman.
- Contemporary Review.
- Cosmopolitan.
- Critic.
- Canadian Entomologist.
- Cassier's Magazine.
- Cumulative Index.
- Detroit Free Press, daily.
- Detroit Tribune, daily.

Delineator.
Drainage Journal.
Entomological News.
Engineering Mag.
  Mechanics.
Educational Review.
Economics Quarterly.
Engineering News.
Farmers' Review.
Forum.
Fortnightly.
Gardening.
Harper's Monthly.
  Weekly.
Irrigation Age.
J'l of Applied Microscopy.
  Franklin Institute.
  Ass'n of Engineering Societies.
  Experimental Medicine.
Johns Hopkins Univ. Studies.
  Circulars.
Ladies' Home J'l.
Library J'l.
Literary World.
Living Age.
Mich. Farmer.
Mich. Fancier.
Mechan's Monthly.
Microscope.
Nation.
Nature.
Nineteenth Century.
N. Amer. Review.
Ohio Farmer.
Outlook.
Political Sci. Quarterly.
Prairie Farmer.
Psyche.
Power.
Physical Review.
Popular Sci. Monthly.
Proc. Acad. of Nat. Sciences.
Pub. Amer. Economic Ass'n.
Quarterly Review.
Rural New Yorker.
Southern Cultivator.
Science.
Scribner.
Scientific Amer.
  Supp.
Vick's Monthly.
Youths' Companion.

Through the courtesy of publishers, or in exchange for college publications, we also receive the following :

Amer. Society of Civil Engineers, Proc.
Adrian Times.
Albion Recorder.
Allegan Gazette.
American Missionary.
  Swineherd.
  Horsebreeder.
  Creamery.
  Horticulturist.
  Bee Keeper.
  Phil. Society Proceedings.
Agricultural Epitomist.
Ann Arbor Democrat.
Bee Gleanings.
Baltimore Sun.
Battle Creek Journal.
Boyne Citizen.
Church Helper.
Corn Belt.
Copemish Courier.
Christian Register.
Clinton Independent.
Chesaning Record.
Chicago Produce.
Detroit Twice-a-week Free Press.
Evening News, Saginaw, daily.
Elgin Dairy Record.
Farmer's Voice.
Farming.
Farm, Field and Fireside.
Farmer's Advocate.
  Home.
Farmer's Guide.
  Journal.
Fruit Grower's Journal.
Good Health.
Grand Traverse Herald.
Grand Rapids Democrat.
  Herald.
Homestead.
Hillsdale Leader.
  Standard.
Home Companion.
Hoard's Dairyman.
Home and Farm.
Indiana Farmer.
Industrial American.
Industrialist.
Ingham County News.
Ionia Sentinel.
Jonesville Independent.
Journal d'Agriculture.
Journal N. Y. Microscopical Soc.
Jackson Patriot.
Kalamazoo Telegraph.
Land of Sunshine.
Lansing Journal.
  Review.
Literary News.
Ludington Recorder.
Michigan Fruit Grower.
Marine City Magnet.
Monthly Weather Review.
Mail and Times.
Midland Republican.
Mirror and Farmer.
Moderator.
Michigan Mirror.
Montcalm Herald.
McBain Chronicle.
Market Garden.
New Ideas.

- New England Florist.
- New York Weekly Witness.
- Onekema Lake Breeze.
- Orange Judd Farmer.
- Official Gazette.
- Public Ledger, Phila., daily.
- Pacific Coast Dairyman.
- Pratt Institute Monthly.
- Practical Farmer.
- Park's Floral Magazine.
- Pennsylvanian.
- Southern Farmer.
- Saginaw Courier–Herald.
- State Republican.
- Sault Ste. Marie News.
- Soo Democrat.
- Sugar Beet.
- St. Ignace News.
    - Enterprise.
- Salt Lake Herald.
- Southern States.
- Sound Currency.
- Toledo News.
- Travelers' Record.
- Traverse Bay Eagle.
- Timely Topics.
- Western Agriculturist.
    - Plowman.
- Wolverine Citizen.
- Wallace Farmer.
- Western Society of Engineers.
- Williamston Enterprise.
- Western Rural.
- Ypsilantian.
- Also M. A. C. Record exchanges.

There are now 20,597 bound volumes in the library. Library hours remain unchanged, students having access to the books eleven hours each day, except Sundays, when the library is open for three hours.

Respectfully submitted,

LINDA E. LANDON,
Librarian.

Agricultural College Michigan, June 30, 1898.

REPORT OF FARM HOME READING CIRCLE.

SEASON OF 1897-98.

PRES. J. L. SNYDER, *Michigan Agricultural College:*

Dear Sir—I herewith transmit a report of the Farm Home Reading Circle, as conducted by its secretary under the direction of the State Board of Agriculture, for the year ending June 30, 1898

During the past year seventy new names have been added to the roll of members, as against sixty-five during the year ending June 30, 1897. Among these seventy new members, who sent in their ages along with their applications for membership, two were over sixty years of age, four between fifty and sixty, seven between forty and fifty, eleven between thirty and forty, nine between twenty and thirty, and eight between the ages of fifteen and twenty.

Since our last report two have finished the Farm Home Reading Circle courses, and have been granted diplomas: F. C. Bulman, Esq., Toronto, Ontario, Canada, and Mr. Frank D. Wells, of Rochester Mich.

With your permission, I take the liberty of including a letter in full as it came to me from Mr. Bulman:

Toronto, June 1, 1898.

Herbert W. Mumford:

Dear Sir—I enclose you ten sheets of foolscap paper, answers to questions on Henderson's Practical Floriculture. I also return questions by your request. This is my last paper completing the three classes, or fifteen examinations, in all three years' work. And if this last examination proves satisfactory entitles me to a suitable diploma for the same.

I can only speak in the highest terms of the gentlemanly and prompt business-like habits that so characterize all the transactions connected with your College.

The rising generations will be a living monument in the near future to the practicability of such a work as the Michigan Agricultural Farm Home Reading Circle is now carrying on, drilling into the students the *why* and *how* science should be practically aplied to the farm.

I am, yours greatly obliged,
F. C. BULMAN,
Toronto, Ontario, Canada.

We are very sure that those interested in the success of the Farm Home Reading Circle will be interested in the above letter.

Out of the sixty-five members, forty started the course with Book I, Class 1, First Principles of Agriculture.

It is difficult to measure the benefit which comes indirectly from one or two hundred men and women who take such a course as outlined. Naturally, these members are scattered from one end of the State to the other. The reading of these books not only helps the individual, but the information which he gathers is spread broadcast among the friends of members of the Farm Home Reading Circle, as they meet in the grange, farmers' club and elsewhere.

One year ago we stated that forty-seven reports had been sent in. During this year sixty-six reports were received, which shows a healthy increase in the interest our readers are taking in the examination idea.

Another encouraging feature of our work has been gradually coming to light during the period which the College has been offering special winter courses. Several who have come to take the special courses have been members of the Farm Home Reading Circle, and have come to get information for which the reading course has given them an appetite. Then, too several of our special course men have joined the Farm Home Reading Circle while in attendance upon the special courses or subsequently, that they might continue their studies.

Respectfully submitted,
HERBERT W. MUMFORD,
Secretary Farm Home Reading Circle.

REPORT OF THE DEPARTMENT OF BOTANY AND FORESTRY.

To the President:

Sir—I have the honor to submit my report for the year closing June 30, 1898.

Students have been instructed as follows:

Freshmen in structural botany, daily for fourteen weeks	134
Freshmen in systematic botany, twice a week for twelve weeks	109
Agricultural sophomores in plant histology, daily for twelve weeks	18
Women in plant histology, three time a week for twelve weeks	17
Sophomores (agricultural and women), three time a week in trees and shrubs for eleven weeks	13
Agricultural juniors in weeds and grasses, daily for seven and one-half weeks	16
Agricultural seniors electing parasitic fungi, fourteen weeks daily	14
Seniors (agricultural and women), work on theses	8
Stockmen, six weeks daily on grasses	9
Home dairymen, three weeks daily on grasses	8
Specialists in horticulture, six weeks daily in botany	3
	349

THE HERBARIUM.

There have been added the past twelve months seed-bearing plants, ferns and their allies from the following sources:

E. S. Steele, Washington, D. C	87
A. A. Heller, plants from New Mexico	255
S. B. Parish, plants from southern California	100
Wm. H. Cusick, eastern Oregon	199
C. G. Pringle, Mexico	150
O. D. Allen, Washington	100
H. E. Brown, California	72
C. A. Davis, Tuscola county	23
Gray Herbarium, Massachusetts	10
Alabama, biological survey	18
Herbarium, Cornell University, Greenland plants	28
C. F. Wheeler and B. O. Longyear, plants from counties of Livingston, Jackson and southeastern Ingham	183
W. J. Beal and C. D. McLouth, Muskegon, city and vicinity	243
C. F. Wheeler and C. A. Davis, Montcalm county	100
C. F. Wheeler, Grand Traverse county	125
C. F. Wheeler, Crawford county	20
Collections made at M. A. C. and vicinity	135
	1,848

Fungi.

Briosi and Cavari, Fasc. 12	25
Sydow, Fasc. 22, 23 and 23b	150
Seymour and Earle	50
Ellis and Everhart, Fasc. 36th	100
Home collections, besides those formerly enumerated	14
	339

Lichens.

Cummings, Williams and Seymour	44

Algæ.

Collins, Holden and Setchell, Facs. 7 and 8	100
Total additions for the year closing June 30, 1898	2,331

GENERAL SUMMARY OF PLANTS IN THE HERBARIUM.

Seed-plants (Spermatophyta)	50,983
Ferns and their allies (Pteridophyta)	1,129
Mosses and Liverworts (Bryophyta)	1,867
Lichens	1,105
Fungi	9,050
Algæ	745
Total number in the herbarium	64,889

"A MICHIGAN FLORA"

Was prepared in 1892 by Beal and Wheeler, and published in the report of the secretary of the State Board of Agriculture. Of this portion, 1,000 extra copies were printed, all of which have been distributed among botanists of this and other states. A revised edition is to be published after an uncertain length of time. Meanwhile, the following additions to our flora is prepared by Professor C. F. Wheeler.

ADDITIONS TO THE MICHIGAN FLORA SINCE 1892.

BY C. F. WHEELER.

Since the publication of the "Michigan Flora" in 1892 there has been a great revival of interest in botanical exploration in our State. Copies of the "Flora" were sent at that time to teachers and others interested in the study of our plants, with the request that an active out-door examination of local plants be made. The results are encouraging. Up to date, 236 plants new to the State have been discovered. The names of those plants indigenous to Michigan are printed in heavy, broad-faced type. The names of those plants which are introduced into our State from the Old World, mainly as weeds are printed in small capitals. Credit has been given to those who have first sent to the College herbarium plants new to the State.

Clematis verticillaris, D.C.

Norway,—S. M. Tobey. Rare.

Anemone patens, L., var. Nuttalliana, Gray.

Norway,—S. M. Tobey. Infrequent.

Ranunculus Purshii, Richards.

Topinabee,—S. H. Camp; Chandler's Falls, Atlanta, Alpena,—C. F. Wheeler.

R. Laponicus, L.

Thunder Bay, Lake Superior.—Britton and Brown.

R. multifidus, var. **terrestris**, Gray.

Ann Arbor,—Miss M. H. Clark; Washington,—Dr. D. Cooley; Lansing,—C. F. Wheeler.

R. Macounii, Britton.

Lake Superior,—Britton and Brown.

R. REPENS, L.

Port Huron,—C. K. Dodge, "A weed in Lawns;" Rochester,—W. A. Brotherton and O. A. Farwell; Montreal River,—O. A. Farwell.

Trollius laxus, Salsib.

Linden,—Dr. A. W. Chase.

Cardamine Pennsylvanica, Muhl.

C. parviflora, L.

These take the place of *C. hirsuta*, L., which I have never seen in Michigan.

Arabis Holboellii, Hornem.

Thunder Bay, Alpena county. The most easterly known station for this western species. C. F. Wheeler.

A. lyrata, var. **occidentalis**, S. Watson.

Bowers' Harbor, Grand Traverse Bay, Alpena,—C. F. Wheeler.

A. confinis, var. **brachycarpa**, Wats. and Coult.

Keweenaw county,—O. A. Farwell; Marquette, Alpena,—C. F. Wheeler.

CAMELINA MICROCARPA, Anderz.

A weed which is becoming naturalized from Europe.

NASTURTIUM SYLVESTRE, R. Br.

Detroit,—O. A. Farwell.

CONRINGIA ORIENTALIS, (L.) Dumort.

A bad weed in grain fields, becoming introduced into Northern Michigan from the Northwest O. A. Farwell.

Erysimum parviflorum, Nutt.

Probably introduced from the West. Clifton,—O. A. Farwell.

SISYMBRIUM ALTISSIMUM, L.

This bad European weed was first introduced into the Canadian Northwest provinces, where it has become a pest. The writer first discovered it at Benton Harbor in June, 1896. At present it is found in a dozen localities, and is likely to prove troublesome.

LEPIDIUM SATIVUM, L.

Port Huron,—C. K. Dodge.

BRASSICA JUNCEA, Cosson.

Lapeer,—Mrs. M. Owen; Agricultural College,—C. F. Wheeler.

DIPLOTAXIS MURALIS, D. C.

Grand Rapids,—H. C. Skeels.

Helianthemum majus, B. S. P.

Vestaburg,—Davis and Wheeler; Muskegon,—Dr. W. J. Beal; Fife Lake, Alpena,—C. F. Wheeler.

L. stricta, Leggett.

Lower falls of the Menominee River,—C. F. Wheeler.

L. intermedia, Leggett.

Port Huron,—C. K. Dodge.

Viola emarginata, (Nutt.) Le Conte.

Munith,—G. H. Hicks; Muskegon,—Dr. W. J. Beal; Detroit,—O. A. Farwell.

V. scabriuscula, (T. and G.) Schwein. Frequent.

V. ovata, Nutt.

Ann Arbor, Grand Rapids,—C. F. Wheeler; Bay City,—Mr. Bradford.

V. tenella, Muhl.

Croswell,—W. W. Wier; Detroit,—O. A. Farwell.

RESEDA LUTEA L.

Jackson,—S. H. Camp.

DIANTHUS ARMERIA, L.

Midland,—E. P. Rice; Rochester,—W. A. Brotherton.

Stellaria borealis, var. **alpestris,** A. Gray.

Alpena, Escanaba, Marquette,—C. F. Wheeler.

SILENE CUCUBALUS, Wibel.

Port Huron,—C. K. Dodge.

Arenaria macrophylla, Hook.

Lake Superior,—Britton and Brown.

Spergularia rubra, Presl.

Litchfield,—W. T. Wallace; Rochester,—W. A. Brotherton.

Hypericum nudicaule, Walt.

Ypsilanti,—O. A. Farwell.

Sida spinosa, L.

Britton and Brown.

Linum medium, (Planch.) Britt.

Port Huron,—C. K. Dodge.

GERANIUM COLUMBINUM, L.

Grand Detour,—Prof. T. C. Porter.

G. ROTUNDIFOLIUM, L.

Britton and Brown.

G. Bicknellii, Britt.

Thunder Bay Island, Alpena county, Escanaba,—C. F. Wheeler; Keweenaw county,—O. A. Farwell.

Oxalis cymosa, Small.

Lansing,—C. F. Wheeler.

Ptelea trifoliata, var. **mollis,** T. and G.

Bald-head Park, Saugatuck,—C. F. Wheeler.

AILANTHUS GLANDULOSUS, Desf.

Port Huron,—C. K. Dodge.

Ampelopsis quinquefolia, var. **vitacea,** Knerr. Frequent.

Vitis Labrusca, L.

Muskegon,—Dr. W. J. Beal.

Polygala incarnata, L.

Port Huron, Walpole Island,—C. K. Dodge. Rare.

P. verticillata, var. **ambigua.** Gray.

Ypsilanti,—Mrs. Lucy Osband; Port Huron,—C. K. Dodge.

TRIFOLIUM DUBIUM, Sibth.

Grand Rapids,—Miss E. J. Cole; Detroit,—O. A. Farwell.

Lespedeza Nuttallii, Darl.

Britton and Brown.

L. Virginica, (L.) Britt.

Munith,—G. H. Hicks; Norvell,—C. F. Wheeler.

PRUNUS MAHALEB, L.

Well established near St. Clair,—C. K. Dodge.

P. nigra, Ait.

From Port Huron northward.

Rubus setosus, Bigelow.

Lansing, Vestaburg,—C. F. Wheeler. Not common.

Fragaria Americana, (Porter) Britton.

Keweenaw county,—O. A. Farwell; Baldwin,—Dr. W. J. Beal; Vestaburg,—C. A. Davis; Alpena.—C. F. Wheeler.

Geum vernum, T. and G.

St. Clair,—Miss Gurd; Belle Isle,—O. A. Farwell. Rare.

POTENTILLA INTERMEDIA, L.

Well established in Livingston and Washtenaw counties. C. F. Wheeler.

P. paradoxa, Nutt.

Shores of the Great Lakes.

Argrimonia mollis, (T. and G.) Britton. Frequent.

Crataegus rotundifolia, (Ehrh.) Borck.

Grand Rapids, Island Lake, Grass Lake,—C. F. Wheeler.

C. macracantha, Lodd. This is our finest native thorn apple.

C. Douglasii, Lindl.

Thunder Bay Island, the only eastern locality known for this western species,—C. F. Wheeler

Amelanchier spicata, (Lam.) D.C.

Shore of Thunder Bay, near Alpena, Grayling,—C. F. Wheeler.

A. rotundifolia, (Ehrh.) Borck.

Grand River Valley,—C. F. Wheeler. Not common.

Drosera longifolia, L.

Mud Lake, Oakland county,—W. A. Brotherton.

LYTHRUM SALICARIA, L.

Found from Detroit to Bay City.

Epilobium palustre, L.

Frequent in swamps.

E. paniculatum, Nutt.

Britton and Brown.

Oenothera biennis, var. **Oakesiana,** T. and G.

Shores of the Great Lakes.

Sicyos angulatus, L.

Ypsilanti,—O. A. Farwell; Port Huron,—C. K. Dodge.

IMPERATORIA OSTRUTHIUM, L.

Britton and Brown.

Thaspium aureum, var. **trifoliatum**, C. and R.

Confined to the two southern tiers of counties.

T. barbinode, var. **augustifolium**, C. and R.

Jackson,—S. H. Camp.

Sanicula gregaria, Bicknell.

Alma,—C. A. Davis; Agricultural College,—C. F. Wheeler.

S. trifoliata, Bicknell.

Alma,—Davis and Wheeler.

Cornus asperifolia, Mich.

Belle Isle,—O. A. Farwell; Homer,—C. F. Wheeler.

Virburnum dentatum, L.

Found at Sarnia, Ont.

Lonicera glaucescens, Rydb. Formerly included in *L. glauca*.

L. TATARICA, L. Escaped from cultivation.

Lansing, Detroit, Port Huron.

Galium Claytoni, Michx.

Britton and Brown. Muskegon, C. D. McLouth.

G. MOLLUGO, L.

Bay City,—G. M. Bradford.

Vernonia altissima, Nutt. Frequent eastward.

V. altissima, var. **grandiflora**, A. Gray.

Frequent in the Grand River valley.

V. glauca, (L.) Britt.

Three Rivers,—C. F. Wheeler.

Mikania scandens, Willd.

Banks of the Muskegon river for a distance of eleven miles above Black Lake,—C. D. McLouth.

Grindelia squarrosa, (Ph.) Dunal.

Probably introduced from the West. At Escanaba,—R. E. Morrell; near Lapeer,—Mrs. M. Owen.

Solidago cæsia, var. **axillaris**, A. Gray.

Frequent near Lansing.

S. bicolor, L.

Rochester,—W. A. Brotherton, J. W. Stacey; Lansing,—Dr. W. J. Beal.

S. tenuifolia, Pursh.

Grand Rapids,—Miss E. J. Cole.

Aster Shortii, Hook.

Pewamo,—C. F. Wheeler; Rochester,—W. A. Brotherton. Rare.

A. longifolius, Lam.

Escanaba,—C. F. Wheeler.

A. polyphyllus, Willd.

Shores of the Great Lakes.

A. paniculatus, var. **bellidiflorus**, (Willd.) Burgess.

Belle Isle,—C. F. Wheeler; Lapeer,—Mrs. M. Owen.

A. cordifolius, var. **polycephalus**, Porter.

Lansing,—C. F. Wheeler.

A. ericoides, var. **villosus**, T. and G.

Marine City,—C. K. Dodge.

Antennaria neodioica, var. attenuata, Fernald.

Agricultural College, Brighton, Vestaburg,—C. F. Wheeler. Detroit, Mackinac Island,—O. A. Farwell.

A. neglecta, Greene.

Lansing, Brighton, Stockbridge,—Wheeler and Longyear; Detroit, Ypsilanti,—O. A. Farwell.

A. campestris, Rydb.

Plains near Grayling,—C. F. Wheeler.

A. Parlinii, Fernald.

Oak Woods, between Brighton and Hamburg,—Wheeler and Longyear.

A. Parlinii, var. ambigens, Fernald.

Banks of Cedar river, on the College Campus, south of the president's house,—C. F. Wheeler.

A. fallax, Greene.

Shores of Grand Traverse Bay, four miles north of Traverse City,—C. F. Wheeler; Detroit, O. A. Farwell.

A. occidentalis, Greene.

Shore of Grand Traverse Bay,—C. F. Wheeler.

A. Canadensis, Greene.

Under pines, shore of Grand Traverse Bay,—C. F. Wheeler; Mackinac Island,—O. R. Farwell.

A. Farwellii, Greene.

Keweenaw Co.—O. A. Farwell; Lansing,—C. F. Wheeler.

Silphium trifoliatum, L.

Avon,—W. A. Brotherton. Rare.

XANTHIUM SPINOSUM, L.

Bay View,—C. W. Fallass; Detroit,—O. A. Farwell.

Heliopsis scabra, Dunal.

Detroit,—O. A. Farwell.

Helianthus petiolaris, Nutt.

Introduced at Hubbardston from the West.

H. grosse-serratus, Martens.

Port Huron,—C. K. Dodge.

ARTEMISIA ANNUA, L.

Detroit,—O. A. Farwell.

A. Stelleriana, Bess.

Port Austin,—C. A. Davis.

SILYBUM MARIANUM, Gaertn. Occasional.

ECHINOPS SPHAEROCEPHALUS, L.

Well established near Three Rivers,—C. F. Wheeler; Grand Rapids,—H. C. Skeels

CENTAUREA NIGRA, L.

Bay City,—G. M. Bradford.

C. CYANUS, L. Escaped from old gardens.

LAMPSANA COMMUNIS, L.

Campus of the Agricultural College.

TRAGOPOGON PORRIFOLIUS, L. Escaped from cultivation.

Hieracium umbellatum, L.

Marquette,—C. F. Wheeler.

H. Marianum, Willd.

Shore of Grand Traverse Bay,—C. F. Wheeler.

Nabalus trifoliatus, Cass.

Washington,—Dr. D. Cooley.

Lactuca Floridana, L. Wayne county.—O. A. Farwell.

Campanula rotundifolia, var. velutina, D. C.

Sandhills of Bur Lake, F. J. Hill.

C. rotundifolia, var. **arctica**, Lange.

Shores of Little Traverse Bay,—C. F. Wheeler; Caribou Islet,—Prof. T. C. Porter.

C. RAPUNCULOIDES L.

Ann Arbor,—A. J. Pieters; Detroit,—O. A. Farwell.

Androsace occidentalis, Pursh.

Niles,—Ralph Ballard.

LIGUSTRUM VULGARE, L.

Woods near the Agricultural College.

Apocynum hypericifolia, Ait.

Washington,—Dr. D. Cooley; Flint,—Dr. D. Clark.

Asclepias pulchra, Ehrh.

A. Sullivantii, Engelm.

Walpole Island,—C. K. Dodge; Tuscola county,—C. A. Davis; Essexville,—C F. Wheeler.

A. quadrifolia, Jacq.

Ann Arbor,—Winchell's Catalogue.

MYOSOTIS ARVENSIS, (L.) Lehm.

Lapeer,—Mrs. M. Owen.

M. laxa, Lehm.

Campus of the Agricultural College.

CUSCUTA ARVENSIS, Beyrich.

Lansing,—C. F. Wheeler.

C. inflexa, Engelm.

Port Huron,—C. K. Dodge.

Solanum Carolinense, L.

Introduced with grass-seed from the southwest.

S. rostratum, Dunal.

Introduced from the west.

Physalis Philadelphica, Lam.

Muskegon,—C. D. McLouth.

P. Virginiana, var. **vulgaris**, Rydb.

Grand Rapids,—H. C. Skeels; Keweenaw county,—O. A. Farwell; Muskegon,—Dr. W. J. Beal White Cloud,—C. F. Wheeler.

P. heterophylla, var. **nyctaginea**, (Dunal.) Rydb.

Howard City,—Dr. W. J. Beal; Barron Lake, Ronald,—C. F. Wheeler.

Scrophularia leporella, Bicknell.

Port Huron,—C. K. Dodge; Island Lake,—Vestaburg,—C. F. Wheeler.

Pentstemon laevigatus, Soland.

Grand Rapids,—Mrs. A. J. Pieters.

Utricularia purpurea, Walt.

Hamlin Lake,—H. F. Blodgett; Marshall,—Dr. W. J. Beal; Pine Lake (Ingham county, Grass Lake,—C. F. Wheeler.

Verbena stricta, Vent.

Grand Rapids,—H. C. Skeels.

AJUGA REPTANS, L.

Bay City,—G. M. Bradford.

MENTHA CITRATA, Ehrh.

Algonac, Walpole Island,—C. K. Dodge.

M. ARVENSIS, L.

Algonac,—C. K. Dodge.

LYCOPUS EUROPAEUS L.

Around elevators and along streets of Port Huron,—C. K. Dodge.

Pycnanthemum linifolium, Ph.

Detroit,—O. A. Farwell; near the Agricultural College,—C. F. Wheeler.

Plantago Virginica, L.

Algonac,—C. K. Dodge.

P. aristata, Michx.

Introduced with clover-seed.

P. MEDIA, L.

Bay City,—G. M. Bradford.

Oxybaphus nyctagynea, Sweet.

Richmond,—W. A. Brotherton; near the Agricultural College,—H. C. Skeels.

O. hirsutus, Sweet.

Grand Rapids,—C. W. Fallass.

Anychia Canadensis, (L.) B. S. P.

Norvell,—C. F. Wheeler; Jonesville,—W. T. Wallace.

Amaranthus spinosus, L.

Detroit,—O. A. Farwell.

Acnida tamariscina, var. **concatenata,** (Moq.) U. and B.

Frequent in Grand river valley.

A. tamariscina, var. **prostrata,** U. & B.

Near the Agricultural College.

CHENOPODIUM RUBRUM, L.

Grand Rapids,—A. C. Skeels; Bay City,—G. M. Bradford.

C. leptophyllum, (Moq.) Nutt.

Bay City,—Charlevoix, C. F. Wheeler; Keweenaw Co.,—O. A. Farwell.

SALSOLA TRAGUS, L. Russian Thistle.

This pernicious weed is now established in over forty cities and towns in Michigan.

Polygonum littorale, Link.

Frequent. Formerly included in *P. aviculare,* L.

P. Careyi, Olney.

Fort Gratiot,—Dr. Z. Pitcher.

P. incarnatum, Ell. Frequent.

P. lapathifolium, var. **nodosum,** (Pers.) Small.

Escanaba,—C. F. Wheeler.

P. ramosissimum, Michx.

Les Cheneaux Islands, Coryell; Alpena,—C. F. Wheeler.

Asarum reflexum, var. **ambiguum,** Bicknell, Keweenaw Co.,—O. A. Farwell.

Britton and Brown.

A. acuminatum, (Ashe.) Bicknell.

Woods near the Michigan Agricultural College,—C. F. Wheeler; Keweenaw Co.,—O. A. Farwell.

Euphorbia glytosperma, Engelm.

Escanaba, Marquette,—C. F. Wheeler.

Euphorbia hirsuta, (Torr.) Weigand.

Saginaw,—C. F. Wheeler; Detroit,—O. A. Farwell.

Quercus Leana, Nutt.

Jackson,—S. H. Camp.

Populus heterophylla, L.

Cass County,—J. H. Roy.

SALIX FRAGILIS, L.

Planted in cities and villages.

ALLIUM VINEALE, L.

In the arboretum at the Agricultural College.

Lilium umbellatum, Nutt.

Alpena, Traverse City,—C. F. Wheeler; Keweenaw Co.,—O. A. Farwell.

Juncus tenuis, var. **secundus**, Engelm.

Palmer park, near Detroit,—C. F. Wheeler.

J. articulatus, L.

Alger,—C. F. Wheeler; Tuscola county,—C. A. Davis.

Lophotocarpus calycinus, (Engelm.) J. G. Smith.

Grand Rapids,—J. G. Smith.

Sagittaria arifolia, Nutt.

Alma,—C. A. Davis; Cedar river, near the Agricultural College,- C. F. Wheeler.

S. cristata, Engelm.

Sarnia Bay,—C. K. Dodge.

Potamogeton heterophyllus, var. **longipedunculatus**, Morong.

Frequent in lakes.

P. interruptus, Kit.

Manistee,—E. J. Hill; Port Huron,—C. K Dodge.

P. rutilus, Wolfg.

Detroit river, between Peche Isle and Belle Isle,—C. F. Wheeler; Round lake, near Jackson,—S. H. Camp.

P. spathulaeformis, (Robbins.) Morong.

New Baltimore, Lake St. Clair,—A. J. Pieters.

Eleocharis acuminata, (Muhl.) Nees.

Shores of lakes.

E. Engelmanni, Steub.

Jackson,—S. H. Camp.

Psilocarya scirpoides, Torr.

Shore of Crooked lake, near Grand Rapids,—Miss E. J. Cole.

Fimbristylis castanea, (Michx.) Vahl.

Port Huron,—C. K. Dodge.

Scripus pauciflorus, Lightf.

Grand Rapids,—Miss E. J. Cole; Port Austin,—C. A. Davis. Frequent northward.

Eriophorum cyperinum, var. **laxum**, (Gray.) Wats. and Coult.

Frequent and variable.

Carex lupuliformis, Sartwell.

Washington,—Dr. D. Cooley; Lansing,—C. F. Wheeler; Alma,—C. A. Davis.

C. lurida, var. **subglobosa**, Fernald.

Near the Agricultural College,—C. F. Wheeler.

C. stricta, var. **decora**, Bailey.

Peche Isle and Belle Isle,—C. F. Wheeler.

C. debilis, var. **interjecta**, Bailey.

Grayling,—Dr. W. J. Beal.

C. Caroliniana, Schwein.

Lapeer,—Mrs. M. Owen.

C. Haleana, Olney.

Frequent in low, clayey ground.

C. interior, Bailey.

Common in swamps.

C. foena, var. **perplexa,** Bailey.

Port Huron,—C. K. Dodge; Muskegon,—Mrs. H. W. Fallass. Northward.

C. pratensis, Drejer.

Pic River, Lake Superior,—C. Loring.

C. straminea, var. **Crawei,** Boott.

Ann Arbor,—Dr. D. Clark; Grass Lake,—C. F. Wheeler.

C. straminea var. **ferruginea,** Gray.

Detroit,—O. A. Farwell; Port Huron, Algonac,—C. K. Dodge.

C. lupulina X. **lupuliformis,** N. hybrid.

Alma,—C. A. Davis.

Paspalum setaceum, Michx.

Detroit,—O. A. Farwell; Lansing,—C. F. Wheeler.

Panicum commutatum, Schultes.

P. filiforme, L.

Agricultural College,—Dr. W. J. Beal.

P. boreale, Nash.

Grand Rapids,—Miss E. J. Cole; Traverse City,—C. F. Wheeler.

P. pubescens, Lam.

Very common near the Agricultural College.

P. flexile, (Gattinger.) Scribner.

Detroit,—O. A. Farwell; Port Huron,—C. K. Dodge; Manchester,—C. F. Wheeler.

P. microcarpon, var. **sphaerocarpon,** (Ell.) Beal.

Jackson,—S. H. Camp; Linden Park, Detroit,—O. A. Farwell.

Calamagrostis Langsdorfii, (Link.) Trin.

Isle Royale,—Prof. T. C. Porter.

Sporobolus neglectus, Nash.

Frequent. Lansing, Saugatuck,—C. F. Wheeler.

Poa glauca, Vahl.

Portage Lake, near Grayling; Isle Royale.

Sieglingia purpurea, (Walt.) Kuntze.

Shore Lake Erie, Monroe county.

Eragrostis Purshii, Shrader.

Norway,—C. F. Wheeler; Rochester,—W. A. Brotherton and J. W. Stacey; Detroit,—O. A. Farwell.

CYNOSURUS CRISTATUS, L.

Agricultural College,—Dr. W.J. Beal; Bay View,—C. W. Fallass.

BRIZA MEDIA, L.

Bay City,—G. M. Bradford.

FESTUCA OVINA, var CAPILLATA, (Lam.) Hack.

College Campus.

FESTUCA OVINA, var. MARGINATA, Hack.

College Campus.

F. rubra, var. **heterophylla,** Hack.

Clifton, L. S.,—O. A. Farwell; Frankfort,—Dr. W. J. Beal; shores of Traverse Bay,—C. F. Wheeler.

BROMUS TECTORUM, L.

Well established and spreading rapidly at Grand Rapids.

B. MOLLIS, L.

Lansing.

B. STERILIS, L.

Lansing.

B. ciliatus, var. **purgans**, (L.) A. Gray.

Frequent throughout.

B. INERMIS, L.

Persists in sandy meadows after cultivation.

B. RACEMOSUS, L.

Detroit,—O. A. Farwell; Alma,—C. A. Davis.

Agropyron Richardsoni, Shreb.

Bay View,—Dr. W. J. Beal; shore of Traverse Bay,—C. F. Wheeler.

A. caninoides, (Ramaley) Beal.

Near the Agricultural College.

A. pseudorepens, S. and S.

Shore of Grand Traverse Bay,—C. F. Wheeler.

Elymus Virginicus, var. **glaucus**, Beal.

Grand River valley,—Dr. W. J. Beal.

E. Virginicus, var. **submuticus**, Hook.

"Grasses of North America,"—Dr. W. J. Beal.

Cystopteris montana, (Lam.) Bernh.

North shore of Lake Superior,—Britton and Brown.

Woodsia glabella, R. Br.

North Shore of Lake Superior. These two ferns will probably be found within our limits.

W. scopulina, (D.C.) Eaton.

Rocks at the lower falls of the Menominee river,—C. F. Wheeler.

Lycopodium alpinum, L.

Keweenaw county,—O. A. Farwell.

Isoetes lacustris, L.

River St. Marie, head of ship canal,—Prof. T. C. Porter.

Equisetum laevigatum, A. Braun.

Port Huron,—C. K. Dodge.

E. robustum, A. Braun.

Port Huron,—C. K. Dodge.

Forty-four plants of the above list are known in one locality only. Forty-seven are from the Old World. Thirty-five are weeds. Sixty-one are from the South and Southwest. Twenty are from the West. Eighteen are confined to the Upper Peninsula.

PRELIMINARY LIST OF CERTAIN FAMILIES OF SAPROPHYTIC FUNGI OF MICHIGAN.

PREPARED BY B. O. LONGYEAR, ASSISTED BY PROFESSOR C. F. WHEELER.

The following list is composed of species identified from material collected during part of three seasons and is preserved in the herbarium. Some of this was collected at Lewiston, Montmorency county, by Dr. Beal. Several other species from the same locality were furnished by H. C. Beardslee. A portion of the species have been collected during one-day trips in different parts of Ingham county, but the greater part of them have been from woods and fields in the immediate vicinity of the College, and mostly during spare hours of time. Three species new to science have been found, and were named by Professor Peck of Albany, New York, but considerable material still remains unidentified.

We are indebted to the above botanist for the identification of a number of species. To the present time, so far as we know, this is the first published list of these families of fungi for Michigan. This is not due to any lack of these plants, but only proves the need of careful field work and study of our fungus flora.

Such knowledge is becoming more desirable because of the inquiries of persons wishing to collect the edible kinds. About forty of the species in these lists are classed as edible, and a number of them have been personally tested.

Those species in which any doubt exists as to identity are followed by an interrogation mark, thus—?

HYMENOMYCETES.

Aagaricus campestris L.
" " L. var. pratensis Vitt.
Aagaricus campestris L. var. silvicola
" Rodmani Pk.
Vitt.
Amanita muscaria Fr.
" rubescens Fr.
" verna Fr.
Amanitopsis vaginata Roze.
Armillaria mellea Vahl.
Boletus brevipes Pk.
" Clintonianus Pk.
" felleus Bull.
" flavidus Fr.
" piperatus Bull.
" scaber Fr.
" cyanescens Bull.
Calocera cornea Fr.
Cantharellus aurantiacus Wulf.
" cibarius Fr.
" dichotomus Pk.
Claudopus nidulans (Pers.) Pk.
Clavaria botrytes Pers.
" cinerea Bull.
" leucotephra B. & C.
Clitocybe dealbata Sow.
" cæspitosa Pk.
" cyathiformis Bull. (Lewiston, Mich., Beardslee.)
Clitocybe illudens Schw.
" infundibuliformis Schaeff.
" sinopica Fr.
" virens Scop.
Clitopilus abortivus B. & C.
" cæspitosus Pk.
" micropus Pk.
" prunulus Scop.
Collybia abundans Pk. (Beardslee.)
" confluens Pers.
" dryophila Bull.
" expallens Pk.
" myriadophylla Pk.
" platyphylla Fr.
" radicata Relh.
" spinulifera Pk.
" succosa Pk.
" velutipes Curt.
Coniophora arida Karst?
Coprinus atramentarius Fr.
" comatus Fr.
" fimetarius var. macrorhiza Fr.

Coprinus micaceus Fr.
“ plicatilis Fr.
Corticium evolvens Fr.
“ mutatum Pk.
“ pezizoideum(Schw.)Shrenck.
“ oakesii B. & C.
“ lilacinofuscum B. & C.
“ simillimum Pk. (new species)
Cortinarius cinnamomeus Fr.
“ violaceus L.
Craterellus cornucopioides Pers.
Crepidotus fulvotomentosus Pk.
“ separius Pk. (new species)

“Pileus thin, convex subumbilicate, even; very minutely squamulose, grayish-tawny; lamellæ adnexed, minutely crenulate on the edge, tawny; stem short, curved, generally eccentric, rarely central, brownish, sometimes mealy or pulverulent; spores broadly elliptical, 9–10 micro-mm. long; 6 micro millimeters broad, commonly uninucleate.

Pileus 4–8 m m. broad; stem 2–4 m m. long.

On oak rails, January.

The grayish tint of the pileus is due to the minute grayish floccose squamules. Occasionally the stem is central and the pileus is slightly umbilicate.”

Cyphella pezizoides Zopf.
Dacryomyces fragiformis (Pers) Nees.
Dædalea confragosa Bull.
“ “ var. polyporoidea Pk.
“ unicolor Bull.
Exidia albida Brefeld?
“ glandulosa Fr.
Favolus canadensis Kl.
Flammula Highlandensis Pk.
Fomes applanatus Wallr.
“ conchatus Fr.
“ carneus Nees.
“ fomentarius Fr.
“ nigricans Fr.
“ pinicola Fr.
Galera hypnorum Batsch?
“ lateritia Fr.
“ tener Schaeff.
“ “ var. pilosella.
Grandinia granulosa Fr.
Guepinia spathularia Fr.
Hydnum caput-Meduseæ Bull.
“ coralloides Scop.
“ ochraceum Pers.
“ septentrionale Fr.
“ Himantia Schw.
“ repandum L.
Hygrophorous pratensis Fr.?
“ conicus Fr.
Hymenochaete corrugata Berk.?
“ tabacina Lev.?
“ rubiginosa Lev.
Hypholoma Candolleanus Fr.
“ perplexum Pk.
Incoybe subtomentosa Pk.
Irpex cinnamomeus Fr.
“ lacteus Fr.
Irpex ambiguus Pk.
“ obliquus Pk.
Laccaria laccata scop.
“ tortilis Bolt.
Lactarius distans Pk.
“ rufus Scop.
“ subdulcis Fr.
“ torminosus Fr.
“ volemus Fr.
Lentinus lepideus Fr.
“ strigosus Fr.
“ tigrinus Fr.
Lenzites betulina Fr.
“ “ var. rufozonata Pk.
“ crataegi Berk.
“ saepiaria Fr.
“ vialis Pk.
“ Klotschii Berk. (Beardslee).
Lepiota acutesquamosa Weinm
“ americana Pk.
“ cristata A. & S.
“ Morgani Pk.
“ naucinoides Pk.
“ procera Scop.
Marasmius campanulatus Pk.
“ epiphyllus Fr.
“ foetidus Fr.
“ Graminum Berk.
“ oreades Fr.
“ rotula Fr.
“ spongiosus B. & C.
“ velutipes B. & C.
Merulius tremellosus Schrad.
Mycena alcalina Fr.
“ corticola Fr.
“ galericulata Scop.
“ Leaiana Berk.
“ sanguinolenta A. & S.
Naucoria pediades Fr.
“ semiorbicularis Bull.
Odontia fimbriata Fr.
Omphalia campanella Batsch.
“ fibula Bull.
“ pyxidata Bull.
Panaeolus campanulatus L.
Panus stypticus Fr.
Paxillus porosus Berk.
Peniophora cinerescens (Schw.) Sacc.
Phlebia pileata Pk.
“ radiata Fr.
Pholiota praecox Pers.
“ squamosa Mill.?
Pleurotus atropellitus Pk.
“ ostreatus Fr.
“ sapidus Kalchb.
“ petaloides Kalchb.
“ serotinus Fr.
Pluteus cervinus Schaeff.
“ admirabilis Pk.
Polyporus adustus Fr.
“ arcularius Fr.
“ brumalis Fr.
“ betulinus Fr.
“ cinnabarinus Fr.
“ elegans Fr.
“ fragrans Pk.
“ galactinus Berk. (Beardslee.)

Polyporus giganteus Fr.
" gilvus Schw.
" lucidus Fr.
" obtusus Berk.
" picipes Fr.
" pilotæ Schw.
" pubescens Fr.?
" resinosus Fr.
" sulphureus Fr.
Polystictus abietinus Fr.
" conchifer Schw.
" hirsutus Fr.
" perennis Fr.
" pergamenus Fr.
" radiatus Fr.
" versicolor L.
" zonatus Fr.
Porothelium lacerum Fr.?
Psilocybe fœnisecii Pers.
Radulum molare Fr.
Russula alutacea Fr.?
" emetica Fr.
" lepida Fr.
" virescens Fr.
Schizophyllum commune Fr.
Solenia anomala Pers.?
" anomaloides Pk.

"Densely cespitose, tufts 2–6 m m. broad; cups stipitate, cyathiform, one fourth to one-half a line broad, externally clothed with an appressed villosity, grayish ochraceous or subcervine, whitish within, the margin incurved; spores oblong or cylindrical, 10–12 5 micro-m m. long, 3–4 micro millimeters broad.

Dead bark of plum trees. February.

This species is closely related to S. anomala, but the cups are more expanded, the villosity appressed and the spores longer. Neither do the cups appear to spring from a visible floccose mycelium."

Stereum Curtisii Berk.
" frustulosum Fr.
" hirsutum Fr.
" ochraceoflavum Schw.
" purpureum Pers.
" striatum Fr.
" versicolor Swartz.
" versiforme Pk.
Strobilomyces strobilaceus Berk.
Stropharia semiglobata Batsch.
Thelephora laciniata Pers.
" Schweinitzii Peck.
Trametes ohiensis B. & C.
" sepium Berk.
" Pini Fr. (Beardslee.)
Tremella intumescens Sm.?
" mesenterica Retz.
Tricholoma albiflavidum Pk.
" laterarium Pk.
" personatum Fr. var. bulbosum Pk
Trogia crispa Fr.
Tubaria furfuracea Pers.
" paludosa Fr.?
Volvaria speciosa Fr.

GASTROMYCETES.

Bovista pila B. & C.
" plumbea Pers.
Cyathus vernicosus D. C.
Geaster hygrometricus Pers.
" minimus Schw.
" saccatus Fr.
" triplex Jungh.
" umbilicatus Fr.
Lycoperdon atropurpureum Vitt.
" cyathiformis (B. & C.) Morgan.
" constellatum Fr.
" elongatum Berk.
" gemmatum Batsch.
Lycoperdon glabellum Pk.
" pedicillatum Pk.
" Wrightii B. & C.
" giganteum Batsch.
Mutinus caninus Fr. (Litchfield.)
Phallus impudicus L.
" Ravenelii B. & C.
Scleroderma vulgare Fr.
" verrucosum vaill.
" Geaster Fr ?
Secotium Warnei Pk.
Tulostoma mammosum Fr.?

ASCOMYCETES.

Our collection of species in this group of fungi has been comparatively small, although we have considerable unidentified material in addition to the following list:

The genus Morchella, containing the edible morels has been rather carefully studied.

Acetabula vulgaris Fckl.
Chlorosplenium æruginosum De Not.
Geopyxis coccinea Mass.
Gyromitra esculenta Fr.
Helotium citrinum Fr.
Lachnea scutellata Gillet.
Leotia chlorocephala Schw.
" lubrica Pers.
Morchella angusticeps Pk.
Morchella bispora Sorok.
" conica Pers.
" deliciosa Fr.
" esculenta Pers.
" semilibera Fr.
Spathularia clavata Sacc. (Beardslee.)
Tapesia aurelia Phil.
Verpa digitaliformis Pers.

MYXOMYCETES.

(SLIME MOULDS.)

The following list of myxomycetes includes a number of specimens received from Mr. H.C. Beardslee of Cleveland, Ohio, collected near Lewiston, Mich. These specimens are indicated by *

Arcyria cinera Bull.
* " digitata Bull.
* " punicea Pers.
*Calonema aureum Morg.
Chondrioderma floriforme Bull.
" globosum Pers.
*Comatricha crypta Schw.
* " typhina Roth.
*Craterium aureum Schw.
* " leucocephalum Ditm.
*Cribraria argillacea Pers.
Dictydium cernuum Pers.
*Diderma effusum Schw.
* " reticulatum Rost.
* " stromatum Link.
* " testaceum Schrad
*Didymium farinaceum Schrad.
Fuligo varians Somm.
*Hemiarcyria ablata Morg.
" clavata Pers.
Hemiarcyria rubiformis Pers.
" serpula Scop.
Lycogala epidendrum Buxb.
*Oligonema pusilla Schrad.
*Ophiotheca Wrightii B. & C.
*Perichænia irregularis B. & C.
Physarum cinerum Batsch.
* " leucophæum Fr.
* " polycephalum Schw.
*Reticularia lycoperdon Bull.
Stemonitis ferruginea Ehr.
" fusca Roth.
* " maxima Schw.
" microcarpa Lister.
" splendens Rost.
Tilmadoche gyrocephala (Mont.) Rost.
Trichia affinis De By.
* " chrysosperma Bull.
* " scabra Rost.
* " varia Pers.

Pertaining to the subject, I include here the following paper read at Ann Arbor in March last, at a meeting of the State Academy of Science:

THE MORELS—MORCHELLA.

BY B. O. LONGYEAR.

The morels constitute a small but distinct genus of saprophytic fungi, belonging to the family discomycetes. They are easily distinguished from closely related fungi by having the pileus covered with branching and anastomosing ridges, which form pits or depressions of varying shapes. The hymenium, or spore-bearing surface, which covers all parts of these ridges and depressions, is thus largely increased in extent. The hymenium is that characteristic of the discomycetes being composed of cylindrical asci and more or less club-shaped paraphyses. Each ascus, with the exception of one species, contains eight ellipsoidal spores. The pileus is borne on a stout, hollow stem, which is lighter in color than the pileus.

While the generic characters are well marked, the specific distinctions are not clear, and it has been very puzzling indeed to decide as to what species many of our specimens belong. All of the material for this subject was collected during the past season and comprises six so-called species, as many as Professor Peck lists for the State of New York.

The species may be arranged in two groups:

(a.) Pileus adnate throughout to stem.

(b.) Pileus with the margin free.

The latter group is made a separate genus by Leveille, under the name Mitrophora. The first group includes four species—*esculenta*, *deliciosa*, *conica, angusticeps.* The separation of these four species, if such they all are, is where doubt and confusion arise. Some of the plants were sent to Professor Chas. H. Peck of the New York State Museum, who kindly reported on the specimens, but without clearing up entirely the identity of some of the doubtful ones. As the asci and spores do not furnish decided specific characters, the species are founded mostly on the form of the pileus and the shape of the pits and direction of the ridges. These differences are shown on the chart, on which I have represented some typical form of each species:

Morchella esculenta (Linn.) Pers. the esculent morel, is easily known by its light buff pileus, having a globular to ovoid form, the pits being of about equal diameter in all directions. In young specimens the pileus has a slight leaden hue.

Morchella deliciosa (Fr.), considered by some to be a variety of another species, has a pileus approaching a cylinder in form, the pits being longer and taking the longitudinal direction; otherwise it seems to closely approach *M. esculenta*, except in size. Only a few specimens of a typical form and size were found.

Morchella conica Pers. is distinguished by its large size and conical form of pileus, also by having the ridges extending in many cases from apex to base of pileus, these being connected by short transverse ridges of lesser height. The pileus in our specimens has a brownish color, which, with the long pits, makes the species tolerably distinct. The ascospores are also usually a little smaller than those of the esculent morel.

Morchella augusticeps. Pk. I have not been able to separate this species readily from *M. conica.* In fact, good types of both were found in an isolated group in the apple orchard. However, another lot of specimens from the College woods consists of nearly all typical forms of the narrow-cap morel. In these the stems were much longer than those figured by Peck, but were identified by him as this species. The tpye of this species is considerably smaller than that of the conical morel, and as its name implies, the pileus is very narrow in proportion to the diameter of the stem.

Another uncertain form of morel was found early in the season and photographed. The pileus is very variable in shape, but the larger ones approach that of *M. esculenta*, while some of the smaller ones are more like that of *M. deliciosa*, as are also the pits.

Some of the specimens were sent to Professor Peck, but were not named. He, however, recommended a careful search for and study of this morel during the coming season. On March 25, of this year, a few specimens were found in a new location, and on March 28, nearly fifty specimens were found in the same location as last season. These early specimens have no spores in the asci. Those found this season approach very closely in general description the delicious morel, with the exceptions of habitat and earliness of occurrence. This morel grows in rather low woods, about the roots of black ash and poplar trees, in moss and decaying wood, as well as on the ground.

A single specimen of a morel answering quite well the description of *M. crassipes* was found by Professor Wheeler. However, I did not feel like taking one specimen as sufficient evidence of the occurrence of this species.

Group *b.* contains two well-marked species.

Morchella hybrida. Pers. (*M. semilibera Dec.*) is readily distinguished by its rather short, conical pileus having the lower half free from the stem, while the pits resemble somewhat those of the conical morel, as does also the color of the pileus. This morel varies much in size and form. In the smaller forms the pileus is large in proportion to the size of the stem, which is occasionally only an inch high and not as large as a lead pencil, while the larger forms have a stem which sometimes reaches a height of six inches with a swollen, distorted base.

Morchella bispora Sorok. has a superficial appearance much like that of *M. hybrida*, but the comparatively thin pileus is white underneath and entirely free from the stem except at the very apex. But its most distinguishing character is that the asci contain only two spores, which are much larger in proportion to their diameter than those of any other morel. A few years ago, Mr G. H. Hicks, a former instructor in botany, found a form of this morel, which was named by Professor Peck *Var. truncata*, on account of the truncate pileus. This variety has also been found by us.

Spores of the different species of morels, when germinated in water, acted much alike. Usually two germ tubes were sent out, one at each end of the spore, and soon formed a branching and anastomosing system of septate mycelium. The union of two spores when in contact was not unusual. In a number of cases the spores of *M. bispora* became once or twice septate during germination.

As to the occurrence of the different species, I may say: *M. esculenta*, the common morel, the morel of my story, while not too cosmopolitan, is sometimes very abundant, especially after warm rains in May and June. At such times one learns to look for its sponge-like head in the grass about certain clumps of evergreens, in open places in the woods, along fences, in orchards and other places where the ground is seldom disturbed. Usually gregarious, occasionally tufted and sometimes solitary in habit, this morel is much sought for by the fungus eater. A half bushel of them was picked at one time from a woods on the College farm by some persons from the city, and I have collected nearly a peck of them in a morning from the same woods during the past season. *M. conica* was found in sufficient numbers at times to furnish a meal, but was at no time plentiful, while typical specimens of the narrow-cap morel were less numerous.

The half-free morel frequents rich, moist woods and seems rather scattered in habit and not especially abundant, although I have been able to fill a vasculum with them at one time.

The small size, thin pileus and uncommon occurrence of the two-spored morel have thus far made it of scientific interest only, although I hope to test its edible qualities during the coming season. Professor Peck mentions this as the rarest of New York morels, he himself never having collected it in that state. We collected nearly a hundred specimens in certain woods near the Campus last season. Tuesday of this week (March 29) I found two immature specimens, the stems of which were no longer than the pileus. Their freedom from the attacks of insect larvæ, the absence of any noxious members of the genus and the readiness with which they may be distinguished from other fungi make the morels about the safest of edible fungi for the inexperienced person to collect. From their dry and somewhat brittle character, one may readily dry them for winter use, and an experiment of this kind enables me to say that it is a successful way of preserving them for eating.

I believe that one cannot do even a season's work along this line without realizing that we have a fungus flora of very rich and varied character, waiting for development by careful field work.

THE BOTANIC GARDEN.

This has been well maintained and in some respects considerably improved. On June 30, 1895, the garden contained 1,335 species and varieties of plants; on June 30, 1897, there were 1,840. The weedy portion of plants has gradually been left to the weed garden, and eliminated from the other portions of the garden, where the plants are arranged by families. Some of the plants inferior in appearance have been abandoned and other species of more importance added.

THE ARBORETUM.

"Notes Concerning a Few Trees in the Arboretum at the Agricultural College," was the title of a paper which I read in August at a meeting of the Society for the Promotion of Agricultural Science, held in Boston.

In 1875, I began planting a small arboretum of about two acres with about 150 species of trees and shrubs. The soil is mostly well drained by nature—a rather thin, sandy loam. In giving results, due allowance must be made for the fact that many of the trees are not suited to the soil, and consequently do not make a favorable showing. This is especially true of swamp white oak, black walnut, butternut, basswood, white ash, catalpa, black ash, hickory, American elm, and others I shall not name.

When the trees were four to six years old, some measurements were made and recorded. At that time I was not well pleased with the progress of the chesnuts, but the success of black walnut, *Catalpa speciosa*, red elm and butternut seemed assured.

Again, after eleven years, my impressions were recorded, and here are a few of them: Butternut does not hold out its rapid growth as well as it promised for a few years at first. White ash was checked for two years by bark lice. The locust trees are few in number, but very fine and healthy. The catalpas are damaged by cold. I will now say, however, that this tree does very well at Ann Arbor, where it grows an clay soil. My report says chestnuts are not all healthy, and are very uneven in size. European larches started off promising well for some time.

Again, after a growth of twenty-three summers, I give you a few notes concerning a few important trees:

Table giving the Age, Height, and Diameter of a few Trees.

NAME.	NOTES.	Age, years from seed.	Height, feet.	Diamet' inches. 1 ft. from the ground.
Swamp White Oak	Tapering; 10 feet up to small branches	23	20	5
Sugar Maple	Branches clear to ground on some of them	22	25	5
Big Shell-bark Hickory (*Hickoria sulcata*)	Eight feet up to small limbs	21	25	5
White Oak	Sturdy; healthy	20	25	
Butternut	Top small, thin; 20 feet or more to branches.	22	35	7
White Pine	Pretty and healthy, some live limbs near the ground, now growing 15 to 18 inches or more each year	22	30	7
White Ash	Twenty feet to limbs; straight and clean	22	35	8
Basswood	About 20 feet to small limbs	22	30	9
Chestnut	Twenty-five feet to live branches; very straight and nice	22	35	10
Common Locust	Twenty-five feet to branches; will make 9 to 10 fence posts	19	40	13
European Larch	Many dying	23	40	13
Balsam Poplar	Not desirable	26	40	14½

A single red pine (or Norway) has done much the same as other trees at the College, but not in the arboretum. They grow in heigh fifteen to twenty inches in one season.

The oldest American beech in the arboretum is twenty-four years old and is rather closely surrounded by other kinds of trees as well as by some beeches. It is 25 feet high, and a trifle less than seven inches in diameter. The trunk tapers upward somewhat rapidly and holds its branches well to the ground. The lower branches are eight or ten feet long. As an ornament for a lawn it would be a pronounced success, but its progress is too slow, when the value of timber is taken into consideration.

A few common locusts were set among the other small trees after these had grown three years or more. Owing to the fact that the trunks were shaded and the locusts few in number and scattered, the borer troubled the trees scarcely at all. According to my present knowledge, I think it safe to scatter a few in thin places in the forest, where the soil is suitable. The timber is very valuable for posts and other uses where exposed to the ground. Under favorable conditions a tree in twenty years will make ten good fence-posts. The locust is one of the trees worthy of study and experiment with reference to growing as a profitable crop—a profitable crop when compared with any ordinary crops of the farm. As it now appears to me in central Michigan, the chestnut is promising to grow for telegraph poles and for other purposes, mixing in a few box elders, evergreens, beeches or something else to shade the ground and keep out the sun and the grasses and weeds. Care must be taken to select land that has a dry, open subsoil.

Without going into detail at present, the following additional species seem to me the most promising for testing in a forest: White ash, white pine, Norway pine for poor sand, and perhaps white oak, shag-bark hickory, basswood and sugar maple for suitable places.

The space between the larger trees of our arboretum is in many places pretty well occupied by a second crop coming on—a self-sown crop, or one sown by wind, birds and squirrels—and consists largely of woody plants in great variety, a considerable portion of which are different from those planted in the rows.

WHAT THE AGRICULTURAL COLLEGE HAS DONE TOWARD A STATE BOTANICAL SURVEY.

The above is the title of a paper prepared by the writer and accepted by the Botanical Section of the American Association for the Advancement of Science at its meeting held in Boston, Mass., last August:

Members of the State Academy of Science are all much interested in the progress of a State Natural History Survey. For convenience, I have here brought together a brief summary of this work, so far as it pertains to botany and this College. For some years past I have, at certain times, taken work upon myself which is usually performed by assistants and instructors, and thus liberated Professor Wheeler or some instructor for a day or two or three, or for as many weeks, to visit certain promising regions of the State, observing, taking notes and making collections for the herbarium and the botanic garden. We intend to do our best to continue this work whenever it is possible to do so. In the interest of agriculture, horticulture, botany and forestry this work seems especially appropriate for an agricultural college.

The names of the publications here enumerated appear neither alphabetically nor in chronological order, but they are grouped more or less according to the reports in which they were printed:

THE FLORA OF MICHIGAN (in "Michigan and its Resources," 1888) Compiled by Frederick Morley, Commissioner of Immigration. The article under the above heading was prepared by W. J. Beal.

THE BROAD-LEAVED TREES OF MICHIGAN (in "Michigan and Its Resources," 1893). Compiled by the Secretary of State. The article here referred to was prepared by W. J. Beal.

MICHIGAN PLANTS THAT AFFORD HONEY FOR BEES. By W. J. Beal. Two papers have been prepared, after a careful study of the flora of the State, with reference to this topic: One of them appeared in *Gleanings in Bee Culture*, Vol. 4 (1876), Medina, Ohio; the other, in the Report of the State Pomological [Horticultural] Society, 1876.

NATIVE TREES AND SHRUBS BEST ADAPTED FOR PLANTING ABOUT A HOME. By W. J. Beal. The report of the State Pomological [Horticultural] Society, 1877.

Report of W. J. Beal, Chairman of the Orchard Committee, in the Report of the State Pomological [Horticulture] Society, in 1873, and again in 1877.

In preparing for the first report, I spent thirty days in visiting the best orchards and vineyards of the State from Monroe to Benton Harbor and Traverse City, and in preparing the second report twenty-five days were occupied in a similar manner.

In visiting some of the very best farming regions of the State in the southern counties, interior counties, lake-shore counties and newer northern counties, we observed the native trees and shrubs and some of the other native plants, especially in the vicinity of the best orchards. Our attention was especially called to the protection of orchards by elevation, by water and by trees and shrubbery. The soil in the vicinity of the best trees in many of the orchards was examined at the surface and to a depth of three feet, and soils from these places were collected and for a time were kept at the Agricultural College.

In general, I may say, we did our best in the hard work of 55 days of two growing and fruiting seasons to make a survey of the State with reference to its capacity to produce good fruit in variety from first-class orchards and vineyards.

In 1875 the writer spent several weeks at different times in various parts of the State, collecting good samples of all the kinds of native trees, and in most cases numerous duplicates were collected. These were exhibited at the Centennial Exposition in 1876. The number of these specimens was 1,115. The report of the State Board of Agriculture for 1876 contains full notes concerning this collection. The following includes some of the sub-headings of the report:

Rare Trees; Most Common Trees; High Trees; Large Trees, with many measurements, noting the exact location of each; Valuable Trees; The Beauty of our Forests.

Most of this collection was returned to the State and placed on exhibition for ten years in the Botanical Museum at the College, but it was nearly all destroyed by fire in 1890. The book of records and entries, however, was saved. The museum was especially rich in Michigan products.

The collection of forest products exhibited at the Columbian Exposition, in 1893, was made by Hon. C. W. Garfield and F. E. Skeels, both graduates of this College. The former is now a member of the State Board of Agriculture; the latter is Assistant Secretary. The most valuable part of the exhibit was sent to the Agricultural College, where it is now in store. The correspondence and full notes regarding these specimens are now the property of the college.

For over two years, Mr. Skeels has spent much time in examining the lands and the forests in Northern Michigan. He selected about twenty characteristic views of certain trees and groups, and had them photographed on large plates, and made full notes to accompany them. At this exposition were shown 721 sheets of Michigan plants.

At various times I have selected and purchased or there have been made for the College, fifty large photographs representing lumber camps, forests and logging scenes. We have 200 negatives of other forest views, and other features of the newer portions of the State.

At large numbers of farmers' institutes held in nearly every county during the past 22 years, the writer has noted the capabilities of the different regions for producing various crops, and the subject has often been freely discussed, eliciting considerable valuable information.

The same is especially true concerning the State Horticultural Society, the meetings of which the writer often attended for eleven years, while professor of botany and horticulture, and since that time as professor of botany and forestry.

The effects of forest fires, with statements of the causes and the consequences on all kinds of life, have repeatedly been the subject of numerous papers and discussions at institutes and meetings of the State Horticultural Society—notably at the State Forestry Convention in 1888.

Considerable information was acquired and recorded concerning the flora of the State in making collections of plants shown at the Columbian Exposition in 1893. This collection represented many phases of the flora as suggested in a report made by Beal and Wheeler, in 1892.

For many years past, a very large number of specimen plants, or parts of plants, have been sent to the College for identification. Some of these have been preserved, and in many cases notes have been made concerning new localities for certain species, and the discovery of those new to the State; also, the advent of weeds and other plants from other countries. A considerable number of these inquiries have come from teachers and others who have been induced to make collections and send to the College. The planting at the College of an arboretum, in 1875 and later, induced us to make strong efforts to represent every tree and shrub to be found in the State. These are now fine object lessons in Michigan forestry. Besides this, about 200 acres, mostly in native forest trees, are managed in the most approved manner to secure a good growth of trees. The same is true in a more extended way regarding all the native and introduced herbaceous plants selected and grown in the botanic garden of three acres for many years past.

The Report of the State Board of Agriculture for 1894 contained an illustrated article giving data regarding the points of difference between sugar maple and black sugar maple of Central Michigan. A similar report for 1893 contains a popular account of the trees of Michigan, their distribution, relative abundance and uses.

In *Garden and Forest*, in 1890—and later copied by the Report of the Michigan Board of Agriculture—may be found an account of the forests and other interesting native vegetation of Central Michigan.

Beginning in 1888 and continuing for four years, the writer was a member of the State Foresty Commission, in connection with Hon. C. W. Garfield. Some work was done in the study of our trees. A forest convention was held at Grand Rapids, and a report was made in 1888. The report deals with forest fires, the succession of forests, methods of lumbering, list of trees and shrubs of the State, and questions answered by numerous experts living in various parts of the State as to why the jack pine is so admirably adapted to succeed itself after fires have destroyed the trees.

For three years the writer made some experiments of a limited nature concerning the growing of forest trees and grasses on the jack pine plains. For this work he made three visits a year, at different times during the growing season, to five different counties north of the central portion of the Southern Peninsula—in all occupying three to four weeks of each year. Many observations and notes were made concerning the country adjacent to these five stations and numerous short excursions were made in various directions. A considerable collection of plants was secured and placed in the College herbarium.

D. Cooley, in 1853, completed his list of plants found growing spontaneously within ten miles of Cooley's Corners, Washington, Macomb county, in Michigan. The large herbarium verifying this list has long been the property of the Agricultural College, where the specimens are well mounted.

L. H. Bailey, later a graduate of the College and still later professor of horticulture, made a list of plants collected at South Haven, in 1880, and records of these plants are preserved at the College.

Charles F. Wheeler and Erwin F. Smith, in 1881, prepared a catalogue of the phænogamous and vascular cryptogamous plants of Michigan, indigenous, naturalized, and adventive. This list was verified by a collection of 1,700 flowering plants and 100 moses collected during a period of twenty-three years. This collection belonged to the Agricultural College; but most of it, unfortunately, was destroyed by fire in 1890. Both of these gentlemen were at one time students of the College, the former graduating in 1891, and for nine years has been the instructor or assistant professor of botany.

In 1891, the College purchased the herbarium of the late Dr. Daniel Clark, of Flint, Michigan, consisting of a little over 5,000 species. This collection was made in Flint, Genesee county, and vicinity, and enlarged by exchanges. It was especially complete in Michigan plants. His notes, also, are now the property of the College.

While a student at this College, and previously, G. H. Hicks devoted much time to collecting and preserving Michigan plants, more especially in Crawford and Shiawassee counties. Mr. Hicks graduated at this College in 1892, and at once became instructor in botany. Notes of all this collection are possessed by the College, as well as 87 species of Michigan plants.

The writer (W. J. Beal) collected, in 1862 and later, and preserved plants, from Lenawee county and elsewhere. In 1889 these plants came into the possession of the College.

G. F. Comstock, in 1845 to 1850, prepared an herbarium of plants collected in Lenawee and Hillsdale counties. These are at the College.

Here, also, are preserved collections made by O. A. Farwell, in Keweenaw county, consisting of 450 specimens, and 101 specimens collected in the vicinity of Detroit.

In 1891, at the expense of the College, C. F. Wheeler visited the southeastern, southwestern and northern portions of the State, making notes, and collected 500 plants.

In 1892, there was purchased for the herbarium a collection of plants, a considerable part of which (perhaps 300 species) was collected in the State by D. A. Pelton, a graduate of the College.

C. K. Dodge, of Port Huron, for some years past has been an industrious collector of Michigan plants. Of these, the herbarium contains 400 species. We also have a unique collection of 46 specimens made in Lake St. Clair, by A. J. Pieters. From Professor C. D. McLouth we have 200 species of Michigan plants, collected in Muskegon county.

From time to time, collections have been made in Central Michigan by Professor C. F. Wheeler, G. H. Hicks, the writer and others, and the specimens are in the herbarium, as follows: Flowing plants, ferns and their allies, 350; fungi, 390.

From Professor C. A. Davis of Alma College, we have received 88 species.

From Professor H. C. Beardslee and Chas. A. Kofoid, we received, in 1890, full notes and many specimens of plants collected in Cheboygan county.

Mainly through the zeal and forethought of the late President E. Willits, in 1888, an examination of the country between Harrisville, in Alcona county, and Frankfort in Benzie county was made by a number of persons working in the interest of the State Forestry Commission and the State Experiment Station. This survey, though lasting for only two weeks, was made in the interests of scientific agriculture in its broadest sense. Besides the writer, the party consisted of L. H. Bailey, the professor of horticulture; C. F. Wheeler, now assistant professor of botany; L. H. Dewey and D. A. Pelton, then seniors of the College. Representatives of *The Free Press* and *Tribune*, of Detroit, were ready to improve an opportunity to gather information for their readers. They composed a part of our company. Four hundred species of plants were collected and a full report of the results embodied in my report for 1888. In the same year Mr. Wheeler and myself spent two days studying the flora of Au Sable and vicinity and making collections.

From time to time, numerous native plants have been examined and records preserved of specimens furnished by W. A. Brotherton of Rochester, Oakland county.

My report referred to contained a list of 26 plants, such as are found almost everywhere on the jack-pine plains, with the addition of 44 which are very commonly found on such lands. Not one of these plants belongs to the large pulse family, which contains peas, beans, clovers, and the like. Lists of plants were made contrasting the flora of the west side of the State with that of the east side, in latitude 44 degrees and 40 minutes.

A report of animal life in the pine woods was made; of wild trees and plants which are ornamental; some peculiarities and possibilities of Northern Michigan.

Embodying the results reached up to date, "The Michigan Flora" was prepared by W. J. Beal and C. F. Wheeler, in 1892. Notes accompanying the names of each species of phaenogamous and vascular cryptogams were quite full, especially as to the localities. The flora was much more than a mere list of plants; it contained a unique text, as will be seen from some of the headings of sections: A map showing ten regions of the State and lists of plants characteristic of each region; trees and shrubs of Michigan compared with those of the rest of the world; why has Michigan so many trees nad Great Britain so few?; plants peculiar to prairies; plants supposed to have immigrated from the north; those from the north and west; planting a grove; planting a wild garden; autumn foliage, with species enumerated for each color; native shrubs bearing beautiful flowers, those distinguished for beautiful fruit, or highly colored bark; native climbing plants; lists of small evergreens; lists of bronze evergreens; plants for winter bouquets; promising native bog plants; promising native aquatics; list of native ferns for cultivation; plants indicating a fertile soil; trees valuable for timber; trees of most durable timber; some wild fruits and nuts with limits for improving; native forage plants; native bee plants; plants for holding hillsides; plants for carp ponds; native and exotic weeds; list of green-leaved parasites; native poisonous plants; botany in the country school; list of native medicinal plants.

DONATIONS TO THE COLLEGE.

From the Gray herbarium of Harvard University, Cambridge, Mass: Plants for herbarium; 10 species of Antennaria.

From the Royal Gardens, Kew, England: 124 kinds of seeds.

From the United States Department of Agriculture, Washington, D. C.: Living specimens of buffalo grass.

From R. H. Pettit, M. A. C.: Two species of puff balls from Minnesota.

From the State Normal College, Ypsilanti, Mich.: Bulbs of white adders, tongue.

From L. D. Watkins, Manchester, Mich.: One branching sterile ear of Indian corn.

From E. W. Crafts, Grass Lake, Mich.: Living plants of small white lady's slipper.

From Dr. Theo. Holm, Brookland, D. C.: Plants of Eragrostis Eragrostis (L.), Karst.

From C. A. Davis, Alma: Plants from Tuscola county, 23.

From W. W. Rowlee, Ithaca, N. Y.: Plants from Greenland, 28.

GIFTS TO OTHERS.

To University of Michigan: 86 kinds of seeds for the botanic garden.

To State Normal College: 11 kinds of aquatic plants.

To Royal Gardens, Kew, England: 44 kinds of seeds.

To Agricultural College, Guelph, Ontario: 22 kinds of seeds of weeds.

To State University, Columbus, Ohio: 58 kinds of living grasses, 66 kinds of seeds.

To Gray herbarium, Harvard University: 375 plants.

Some exchanges and purchases of seeds and plants are not here recorded.

I spent two weeks at farmers' institutes, a portion of the time during vacation. The pressing demand of classes prevented further absence for institute work.

My thanks are tenderd Professor C. F. Wheeler and Instructor B. O. Longyear for valuable work and great interest taken in all that pertains to the department. I am

Yours truly,
W. J. Beal,
Professor of Botany and Forestry.

Agricultural College, Mich., June 30, 1898.

DEPARTMENT OF HISTORY AND POLITICAL ECONOMY.

To the President:

Sir—I have the honor to submit the following report concerning the work done in the department of History and Political Economy during the year 1897-98:

My duties as teacher during the school years indicated above began with the winter term. A class consisting of twenty-three students, mostly seniors, was given instruction five days per week during this term in economics. A class of seniors numbering nine recited in logic five days per week, also, while the junior class, numbering twenty-three met each school day during the term in the study of civics. The general method of conducting these classes has been much the same as that outlined to your in former reports and in the College Catalogue. The texts used in the classes metioned were, respectively, Walker's Political Economy, Jevon's Logic and Fiske's Civil Government, together with Hoffman's Sphere of the State.

An additional subject was intrusted to this department during the spring term in the study of General History, given in the Woman's Course. The class during this term numbered twenty-six, using Fisher's History of the Nations as a text, and recited each school day in the term. The customary course in the Constitutional History of the United States was given to a senior class of fifteen during this term and a short course of ten lectures on the history of agriculture in our country was given, as in the two previous years, to the class of seniors in agriculture.

During this year the study of Logic was transferred from my care to the department of English, where it could be more closely connected with the study of composition than before.

Not a little attention has been given during the year to considering and selecting desirable books in history and economics for the library. The number of new books in these subjects each year is so vast that a judicious selection is almost as difficult as it is necessary.

In conclusion, I wish to thank yourself and the State Board of Agriculture for the benefits of a stay of six months in Europe, comprising the autumn term of this year and the preceding vacation. Most of this time was spent in Germany, in a study of Old World society and conditions, which I hope will prove helpful in teaching civics and economics. The remainder was used largely in England, where the acquaintanceship made with English places and institutions which constitute so much of English history must be useful in teaching that history as well as our own.

Very respectfully submitted,
WILBUR O. HEDRICK,
Assistant Professor in History and Political Economy.

REPORT OF DEPARTMENT OF DRAWING.

President J. L. Snyder:

Sir—I have the honor to submit the following report for the Department of Drawing for the year ending June 30, 1898:

The increase in attendance made it necessary to employ assistance in some of the work. The number of freshmen taking mechanical drawing being double what it was the preceding year, the class was divided into two sections, Mr. Chace Newman taking charge of one. The same arrangement continued with the class in machine sketching.

I wish here to testifiy to the conscientious work of Mr. Newman and the eminently satisfactory manner in which he has conducted his classes. The remainder of the work of the department in the Engineering Course has been provided for as usual.

The number of students in each section in free-hand drawing (about 60) rendering it impossible for one person to do the instructing alone, the services of Mrs. E. M. Kedzie were secured, to the manifest benefit of the students, both Mrs. Kedzie and myself spending the entire morning in the studio.

The sophomore women took work in drawing during the three terms of the year, an average of about three hours per week. This work, when the course is in full running order in charge of the assistant whom I have been empowered to select, will, I hope, be of marked value.

The one thing which causes trouble and annoyance to both students and instructors is the lack of properly lighted, ventilated and equipped rooms. In view of the increasing attendance, some arrangement ought to be made for enlarging the accommodations for this department at an early date.

Faithfully,
W. S. HOLDSWORTH.

REPORT OF WORK IN THE ENGLISH DEPARTMENT.

To the President of the Michigan Agricultural College:

Sir—The following is a brief report covering the work in the English Department for the year 1897-98:

The working force of the department remained the same as in the year previous, with the exception that, owing to the largely increased attendance and the consequent increase of divisions and of essay work, the librarian was, with your approval, employed to take some class work and essay work. The arrangement will be continued in the year 1898-99.

The year ends the connection of Professor A. B. Noble with the College, he having accepted a position as professor of English in the Iowa Agricultural College. It is fitting that I here record my appreciation of his long, earnest, intelligent, and laborious work in this department. It is a source, too, of congratulation to ourselves and to the College that the system of work we have evolved to meet the peculiar requirements of an Agricultural College Course and the pressing needs of the material that composes the freshman class in such a course has already met such flattering recognition as is implied in the desire to transplant our system to a sister institution where the problem to be solved is the same as our own. I greatly rejoice in Professor Noble's well-merited promotion, and shall always feel sincere gratitude to him for his unfailing zeal and wise counsel in the work of the department.

The plan of English work adopted in the Agricultural Course at its reorganization has been continued throughout the past year, and justifies itself more and more emphatically as time goes on. Its basal principles are a minimum of theory with a maximum of practice—the attention directed primarily to the thought and secondarily to the form in which the thought is couched; the careful study of the successful solution by great writers of problems of expression, and constant, persistent, untiring exercise upon these problems in a carefully graded course of exercises extending through the whole four years. These principles, no doubt, have been in theory fully accepted by all teachers from time immemorial; but the detailed adjustment of them to our condition has been a matter of long and painful evolution, and was finally successful, in as far as we can flatter ourselves that we have attained success, only through a revisal and re-arrangement of the entire agricultural course in all its departments, under a resolution of the Board of Agriculture in 1895 appointing a committee, of which I was a member, to investigate the course, determine its defects, and suggest desirable changes. The opportunity to revise the English course in its entirety was eagerly seized, and the course now in operation was the outcome.

I would call your attention to the fact that in this new arrangement the work of the teachers has been increased three-fold, notwithstanding that the actual number of class-room hours remains the same. This is brought about by scattering the hours of recitation over all the terms instead of condensing them into a few terms, as was previously the case, and by requiring in every term the same amount of essay work as was previously required only in those terms where the class work was placed. This increase of work with the individual, coupled with the doubling of the attendance at the college, makes the present arrangement of the teaching force quite unsatisfactory, and some plan will in the near future have to be devised to increase the working force at our disposal.

Very respectfully yours,

HOWARD EDWARDS,

Professor, English and Modern Languages, Michigan Agricultural College.

AGRICULTURAL COLLEGE, August 30, 1898.

REPORT OF DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

To the President:

I have the honor to submit my report for the Department of Physics and Electrical Engineering for the year ending June 30, 1898.

The regular classes in Physics have been carried on without change. The increased number of students has not materially increased the work in the lecture courses. The only inconvenience, so far, has been the low seating capacity of the lecture room. Outside of the regular lectures, two important changes have been introduced. First, a seven weeks, course in the fall term for agricultural sophomores in physical laboratory practice. The time allowed and the place assigned in the course are the best that could be selected. The agricultural sophomores are at the same time on the last half term of the regular one-year course in general physics. The class expressed themselves as having received both pleasure and profit from the course. The second change was the elimination from the woman's course of the third term in general physics and the substitution in its place of a term of domestic physics. Four hours per week is devoted to quantitative work having direct applications in modern domestic science; three hours per week to lectures and discussions. Ten women took the course. The work is important and interesting and capable of being developed into an exceedingly valuable course.

The laboratory practice courses have required the most careful consideration. A course adopted to the needs of our students and fitting our limited equipment for laboratory work had to be devised and worked out in all its details. The laboratory work occurs in periods of two hours each. Upon this time basis and a modest money limit such a course has been laid out. In the first place, the course is strictly quantitative, all authorities agreeing that this is necessary to prevent mere trifling with apparatus. Second, practical utility has been made an essential in selecting each experiment. The experiments are those which have the most important and frequent applications in life. Third, laboratory forms were decided upon as the result of several years' trial with various methods. Two hours' work is laid out on each form. By the use of the form, the student is guided in his thinking, but is not at all relieved from the necessity of thinking, and he is at the same time enabled to derive full benefit from the quantitative work.

The size of the divisions for laboratory practice is of great importance. Comparatively, but a small number can be directed to advantage at one time. In the physical laboratory practice room sixteen would be a fair limit. It has been necessary repeatedly to attempt to instruct as many as forty at one time. The instructor should be able to get to the table of each student at frequent intervals, in order to check errors and useless work owing to misconception of the conditions of the experiment. The crowded condition has often resulted in confusion, loss of time and poor work.

Almost all the apportionment for the past year has been needed to pay for material for laboratory work and to replace and repair apparatus. I can report the addition of a fine volt meter, made by the Western Electrical Instrument Company.

Quite a large portion of my time for the past year has been devoted to engineering work, due to my appointment by the State Board as College Electrical Engineer and my duties as a member of the committee on the installation of the College light and power system. A detailed report of the work of this committee will be found under its proper heading. I wish to express my appreciation of the work of Mr. George N. Eastman, who assisted me in drawing the plans and specifications used in the installation of the College electrical equipment. I also wish to thank the members of the State Board of Agriculture and yourself for encouragement and assistance received.

Most respectfully,
PHILIP B. WOODWORTH.

ELEVENTH ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

UNDER THE HATCH ACT

FOR THE

YEAR ENDING JUNE 30, 1898

(For members and organization of the State Board of Agriculture in charge of the Station, and list of officers, see pp. 4 and 5 of this volume.)

EXPERIMENT STATION.

REPORT OF SECRETARY AND TREASURER.

The following account shows the receipts and expenditures of the Experiment Station for the year ending June 30, 1897:

July 1, 1897—To	balance on hand	$2,779 12	
July 9, 1897	received from U. S. Treasury	3,750 00	
Oct. 8, 1897	received from U. S. Treasury	3,750 00	
Jan. 7, 1898	received from U. S. Treasury	3,750 00	
April 8, 1898	received from U. S. Treasury	3,750 00	
June 30, 1898	license fees on 69 brands commercial fertilizers	1,380 00	
	miscellaneous receipts, mostly farm products	281 66	
June 30, 1898—By	disbursements as per vouchers filed in the office of the State Auditor General		$17,740 26
July 1, 1898	balance on hand		1,700 52
		$19,440 78	$19,440 78

Thirty-five thousand copies of station bulletins are now issued, and the demand is increasing as farmers learn of their value. Several press bulletins have been issued and special information in bulletin form has been sent out by the station.

DISBURSEMENTS ON ACCOUNT OF U. S. APPROPRIATION.

Salaries:		
Director and administrative officers	$1,220 00	
Scientific staff	4,800 00	
Assistants to scientific staff	2,400 00	
Special and temporary services	15 09	
		$8,435 09
Labor:		
Monthly employés, three, average rate, $33.00	$1,112 00	
Daily and hourly employés, $1.28	1,963 56	
		3,075 56
Chemical supplies:		
Chemicals	$354 21	
Other supplies	97 55	
		451 76
Publications, envelopes, cuts, etc	$248 87	
		248 87
Seeds, plants and sundry supplies:		
Agricultural	$48 55	
Horticultural	81 43	
		129 98

Furniture and fixtures:		
1 case	$9 00	
1 desk	12 50	
Earthen ware	4 20	
Sundry small fixtures	80	
		$26 50
Scientific apparatus:		
1 microscope	$37 50	
1 condenser	7 20	
1 selerite	2 50	
1 hæmactometer	9 50	
1 Steinheil pocket lens	2 50	
1 honey extractor	10 00	
1 photo-micrographic apparatus	26 00	
1 set scales and weights	16 23	
Sundry small apparatus	120 36	
1 tintometer	54 80	
1 Koch burner	4 80	
1 doz. clinical thermometers	22 76	
		314 15
Contingent expenses		296 70
Live stock:		
Horses	$2 50	
Sundries	76 00	
Poultry	21 61	
		100 11
Traveling expenses:		
In supervision of station work	$172 39	
In attending farmers' institutes and other meetings	81 26	
		253 65
Building and repairs:		
Cold storage fruit house		750 00
Postage and stationery		170 76
Freight and express		154 49
Fertilizers		15 14
Feeding stuffs		367 65
Library		209 59
Total		$15,000 00

DISBURSEMENTS OF EXPERIMENT STATION—MONEYS OTHER THAN RECEIVED FROM UNITED STATES TREASURER.

Salaries	$747 54	
Labor	750 29	
Publications	155 96	
Postage and stationery	8 58	
Taxes and rent of land	208 37	
Seeds, plants and sundry supplies	102 88	
Library	11 25	
Live stock	24 00	
Traveling expenses, freight and express	11 05	
Building and repairs	706 47	
Scientific apparatus, chemical supplies	12 72	
Contingent expenses	1 15	
		$2,740 26
Balance on hand		1,700 52
Total		$4,440 78

SUMMARY OF TOTAL DISBURSEMENTS—CLASSIFIED FOR DEPARTMENTS.

Buildings and repairs to buildings	$1,452 39
Library	220 84
Farm	2,537 23
Garden	587 08
Chemical	383 05
Botanical	141 70
Zoölogical	13 92
Veterinarian	1,079 81
South Haven Station	1,989 21
Salaries	8,298 77
Apiary	240 67
Office	655 18
Sundry	140 41
Total	$17,740 26

REPORT OF THE DIRECTOR.

To the President:

I have the honor to submit herewith my annual report for the year ending November 1, 1898:

There have been issued to June 30, 1898, and since June 30, 1897, the following bulletins:

No.	Title.	Author.	Dept.	Pages.
145	Fertilizer Analyses	R. C. Kedzie	Chemical	24
146	Bacteria and the Dairy	C. E. Marshall	Bacteriological	20
147	Pasteurization of Milk	C. E. Marshall	"	28
148	Strawberries	L. R. Taft and H. P. Gladden	Horticultural	16
149	Feeding Dairy Cows	C. D. Smith	Agricultural	56
150	Sugar Beets in Michigan in 1897	C. D. Smith and R. C. Kedzie	Agricultural and Chemical	38
151	Raspberries, Blackberries and Grapes	L. R. Taft and H. P. Gladden	Horticultural	12
152	Report of South Haven Sub-Station	T. T. Lyon	"	60
153	Vegetable Tests, 1897	L. R. Taft, H. P. Gladden and M. L. Dean.	"	26
154	Some Experiments in Corn Raising	C. D. Smith	Agricultural	32
155	Spraying Calendar for 1898	L. R. Taft	Horticultural	18
156	Preliminary Report of State Inspector of Nurseries and Orchards and laws relating to the same	L. R. Taft and D. W. Trine	"	11
157	Hog Cholera	G. A. Waterman	Veterinary	8
158	Some Experiments with Poultry	C. D. Smith and C. S. Brooks	Agricultural	16
159	A Study of Normal Temperatures and the Tuberculin Test	C. E. Marshall	Bacteriological	51
160	Some Insects of the Year 1897	Rufus H. Pettit	Zoölogical	41
161	Fertilizer Analyses	R. C. Kedzie	Chemical	17

In addition to the regular bulletins, of which seventeen have been issued in the period mentioned, there was begun in December, 1897, the publication of a series of elementary science bulletins, designed for use in the nature study work of the common schools of the State. Four bulletins in this series have been issued. The work is carried forward by a joint committee of the Experiment Station Council and the College faculty.

I am very glad to report that there were few changes in the working force of the Station to interfere with the carrying forward of experiments in the period covered by this report. Professor A. A. Crozier was obliged to sever his connection with the Station in March, 1898, on account of continued ill-health. It is unnecessary to speak either to yourself or to the board of the marvelous assiduity with which Mr. Crozier applied himself to his work. He was painstaking and conscientious in details to a degree that is seldom found among the most devoted scientific workers. He was intense in his application, to the sacrifice of his health. The excellence of his work has been demonstrated in the bulletins already issued from his pen and in the lines of work planned and begun by him.

For his successor, Professor J. D. Towar, for seven years connected with the Rhode Island Experiment Station, was chosen. He arrived at the Station June 1, 1898—too late to take part in planning the field work of the season, but in time to carry the experiments to a successful conclusion. By action of the board, Mr. Towar has been made agriculturist of the Station and a member of the Council.

Early in the year Mr. Thorne Smith left us to do commercial work, and later to become assistant chemist, of the Idaho Experiment Station. Mr. L. S. Munson, a graduate of this College in the class of 1897, was appointed to succeed him.

The mailing list, or the list of people to whom the bulletins are sent regularly, has grown rapidly during the year, until at the close of the season—November, 1898—it numbered over 24,000. This number may be taken as a fair enumeration of the families to which our bulletins have access. It is a reasonable supposition that the vast majority of these families live upon farms, or, if living in cities or villages, own or operate farms. The influence which the Station exerts upon the agriculture of the State is therefore growing and becoming an important factor in the betterment of farming methods.

Nearly all phases of the work on a diversified farm have received some attention at the hands of the Experiment Station during the past year. If the interests of the farmer have lain solely along the line of field crops, the bulletins on "Fertilizer Analyses," "Sugar Beets in Michigan," "Some Experiments in Corn Raising" and "Insects of the Year 1897" cannot fail to have been of value to him. These bulletins have reported work not only original but of so practical a character as to be applicable immediately to the work that such farmer would have on hand. The results of experiments along lines of live stock are relatively slow to mature. During the year the dairy side of animal industry has received much attention. The two bulletins of Mr. Marshall relating to the bacteria of the dairy and pasteurization of milk have pointed out the friends and enemies of the dairyman in the microscopic world, and the method by which the intelligent butter or cheese maker may so control these minute but all-powerful forces as to secure their coöperation in the production of a first-class product. These bulletins have been in no wise compilations, but report results of original investigations. So the bulletin on Feeding Dairy Cows has brought together the observations made upon the behavior of the College herd for several years, during which a record has been kept both of the feed consumed and the milk and butter yielded by the individual cows.

The bulletin on "Normal Temperatures and the Tuberculin Test" treats of a subject of pressing interest to the live-stock breeders of the present time. No experiments have ever been carried on, the results of which go to disprove the proposition that the tuberculin test is the best diagnostic agent for the detection of tuberculosis. The experiments of Mr. Marshall call attention to the dangers surrounding the use of the test either in incompetent hands or in the hands of those who have neither desire nor opportunity to note the normal temperatures of the animals for a sufficient time previous to the hypodermic injection, and to the possibility of mistaken diagnosis, owing to the possibility of a normal rise of temperature without the use of tuberculin. There seems to be no justification for the demand that all animals responding to the test shall be immediately slaughtered, because there is no demonstration of the claim that all animals reacting are dangerous either to their stable mates or to the human family. On the other hand, so subtle and fatal is consumption that if tuberculin demonstrates the probability of the presence of the disease that fact is enough to condemn the animal to isolation and to prevent the sale of either the milk and butter produced by it or its carcass.

There has been during the summer of 1898 an unprecedented loss of swine, not only in the southern tier of counties, but in the State at large. Epidemics have broken out in first one locality and then another, and the total loss has been large. The symptoms have been such as to lead the local veterinarians to pronounce the outbreaks hog cholera. I call your attention to the report of Dr. Waterman and Mr. Marshall upon these outbreaks and the results of their examinations of materials collected and their inability to find the germ of the usual form of this disease. The Station, through its veterinary department, is making an examination of this question—leading, I hope, to results of the utmost consequence to swine breeders. It seems evident that we have to deal not with the form of so-called hog cholera produced by the well-recognized germ described in the bulletins and reports of the Division of Animal Industry of the Department of Agriculture at Washington, but with outbreaks in which, while the symptoms are suspiciously similar to those of hog cholera, the causes are various and, unfortunately, widespread. It is the aim of the investigations now in progress to discover these causes and suggest preventive measures.

Michigan is by reputation one of the first states in the Union in respect both to the quantity of tree and small fruits produced and their quality. The Horticultural Department has issued bulletins during the year on topics relating to the vegetable and small fruit garden, as well as to the orchard and nursery. The results of the work at South Haven become yearly of more and more value as the plantations of fruit trees come into bearing. The appearance annually of new pests in the shape of insect enemies and fungus diseases keeps the zoölogical, botanical and horticultural departments continually on the alert to discover these enemies on their first approach and to find means for combating them.

The work with sugar beets has been continued during the season of 1898, taking as the topic for investigation the cost of production. The building and successful operation of the beet sugar factory at Bay City seemed certain to create increased interest in this subject and to call for further attention to it on the part of the Station. The results of the experiments conducted in 1897 were published since the last report of the Station was written, in Bulletin 150. This bulletin showing as it did that the average per cent of sugar in the Michigan grown beets was higher than in beets grown in any other state of the Union save one, was of great value to those sections of the State interested in establishing sugar factories in the immediate future. It was equally valuable to the beet-raiser, as it gave him in explicit terms both the directions for growing his beets and the results he might hope to attain.

The Chemical Department has worked in collaboration with the Agricultural along several lines, the most conspicuous of which is the test of sugar beets. This department has also performed a signal service to the farmers by analyzing commercial fertilizers, as the law directs, and thus preventing fraud. The results of other lines of work, especially those connected with the analyses of flours and determinations of relative values of different grades, are not yet ready for publication, but include a large amount of work.

I submit herewith the reports of the agriculturist, horticulturist, chemist, bacteriologist, consulting zoölogist, consulting botanist and apiarist, and a copy of each of the bulletins issued during the year, which are included and made a part of this report.

Respectfully submitted,
C. D. SMITH,
Director.

AGRICULTURAL COLLEGE, MICH., NOV. 1, 1898.

REPORT OF THE WORK OF THE AGRICULTURAL DEPARTMENT.

To the Director:

The following is a report of the work of the Agricultural Department of the Experiment Station, for the period between June 1 and November 1, 1898:

Upon taking charge of this Department on June 1, 1898, the work for the season was fully planned and well under way. The area of ground placed under the charge of this department consists of the experimental plots in Fields No. 3 and 5, and a portion of Field No. 6, which is being used for trials with forage crops and for testing varieties of wheat and corn.

WHEAT.

Tests of varieties were conducted in Field 6, where long narrow plots has been sown and the conditions obtained as nearly uniform as possible, resulting as follows:

Variety.	Yield per acre, bu.
Dawson's Golden Chaff	42.59
Dawson's Golden Chaff from original seed	30.18
Russian	31.02
Surprise	30.33
Currell	28.29
Rudy	27.87
Chaplin	25.83

In Field No. 16, White Clauson yielded 23.74 bushel per acre and the Buda Pesth 20.64 bushel to the acre. A comparison of the yields between 6 and 16 would be misleading, owing to the wide differences in the fertility of their soils.

Small plots of the following varieties were harvested from Field 6 and the more promising ones sown under favorable conditions again this fall: Red Lorraine, Red Altkirche, Barnatka, Plymouth Rock, Krimish, Sandomir, Red Bearded, Early Arcadian, Earl's Velvet Chaff, Perfection, Reliable Minnesota, Genesee Giant, Nigger, Red Senora, Spelt, Soft Angora, Chaplin, Surprise, No. 6, Sterling and Egyptian.

In Fields 8 and 14, wheat has been sown this fall in a manner to afford a test of several of our more prominent varieties, while also in Field 8 is an experiment in cultivation.

Wheat Smut.—Careful observations were made upon the College wheat fields to discover the presence of either of the smuts that visit this locality. None of the varieties were infested with the stinking smut, while loose smut appeared only on the Surprise wheat in No. 6. Numerous reports of the presence of wheat smut in various parts of the State came to this office, with requests for remedies for the same. Accordingly, Press Bulletin No. 12, on "Treatment of Seed Wheat for Smut," was issued and distributed to the farmers, millers and newspapers.

Experiments with Wheat Smut.—Owing to the general prevalence of the stinking smut and the pressing demand for simple remedies for its destruction, a quantity of badly smutted wheat has been purchased and experiments begun to test the relative efficiency of the various remedies now in practice. These experiments involve the use of corrosive sublimate, copper sulphate and formalin, used in various degrees of strength and quantity. It is also proposed to try some experiments this winter upon the feeding value of badly smutted wheat.

OATS.

Tests of varieties of oats in connection with field crops were conducted in Fields No. 8 and 15, with the Scottish Chief, American Banner, Brown's American Banner and Michigan Wonder varieties, resulting in yields in the order given.

Oat Smut.—Under Professor Wheeler's direction, a small area in Field No. 3 was sown to oats to test the efficiency of formalin, corrosive sublimate, copper sulphate, and hot water as remedies for oat smut. Observations on the untreated plots in this experiment and on several oat fields in this locality revealed the fact that the oat smut is becoming extinct in the neighborhood of the College. This may be due to the unfavorable conditions of the season for the development of the smut fungus, but is more than likely a result of former treatments of seed oats by the farmers in this vicinity and the growing of oats from treated seed sent out by this department. The absence of the smut on the untreated plots, while gratifying in one respect, detracted somewhat from the value of the experiment.

CORN.

In Field 11, experiments on various methods of planting and drilling corn were tried with a view to determine by which method the farmer can produce the greatest amount of dry matter and nitrogen free extract. In Field 6 a test was made with thirty common varieties, the results of which are being prepared for publication in bulletin form.

OTHER FORAGE CROPS.

The east end of Field 6 was devoted to the growth of oats and peas, sorghum, rye, Kaffir corn, sowed corn, and winter vetch, to be used as summer feed for the College herds of cattle. Each of these crops produced a normal growth and came to proper feeding state at the right time to keep up a continual supply of green feed throughout the dry season during July, August and early September. The winter vetch (vicia villosa) was sown in August, 1897, and was ready to cut by June 10. Although the cattle did not relish this as green feed, its abundant growth and the particular date at which it attained its full size recommend it as a crop for winter covering and green manuring. Seed of the winter vetch was sown last spring in the Curiosity strip, in rows three feet apart, and produced a dense growth by October 1, at which time it was in blossom and completely covered the ground.

CLOVER.

Trials of alsike, Russian, mammoth and June clover by direct seeding—without a nurse crop—are being conducted on the experimental plots. Each of the varieties has made a fair growth, although it has required three mowings to keep down the weeds during the summer. A seeding of clover on an adjoining wheat plot resulted in complete failure, while the seeding in No. 16 was a success, except on the most exposed knolls. Attention is called to the fact that a good catch of clover was secured on old ground without a nurse crop, while in wheat adjoining not a stalk of clover grew, and furthermore, a good catch was obtained in No. 16, which is a comparatively new field, the wheat being the third crop it has borne.

SAND LUCERNE (MEDICAGO MEDIA).

This plant, resembling alfalfa, has been grown upon two plots of light sandy soil in Field No. 3, from which a large part of the surface soil has been removed.

Three crops of hay were cut from each of these plots, with yields per acre as follows:

	June 9.	July 15.	Sept. 3.	Total
North Plot	3,900	1,700	1,200	6,800
South Plot	2,930	1,849	1,138	5,917

In addition, a fourth crop, fully equal to that of September 3, might have been cut October 10, but was left to serve as a winter protection to the plants.

WOODS AND FOREST PLANTATIONS.

The College woods are being maintained by removing the dead and dying trees and allowing the young growth to occupy the ground where the larger trees have been removed. No stock is allowed to pasture in the woods, and a dense growth of small trees has now taken possession.

The plantations of white pine along the west border of the farm and in the field east of No. 7, on the river bank, have been kept clean, perfectly free from weeds, during the summer, and have made a growth of from 10 inches to 16 inches, in height.

The expense of caring for these young trees has caused a severe drain on the funds of the department, while at the same time the work has somewhat interfered with the pressing demands for our time upon the other growing crops.

CURIOSITY STRIP.

This is a plot of ground on the experimental fields, some 39 rods long and 4 rods wide, which for the past few years has been planted in small areas to such new and curious plants as the department has from time to time received for trial and experimentation. This strip has served a two-fold purpose—that of a test of the plants tried there and as a convenient place to display such plants for study by students and visitors.

The perennial plants have been arranged by themselves at the east end, while the annuals are grouped, as far as possible, in families and with reference to their economic uses. It is here that many of the new plants have made the promise that led to their trial and introduction into the larger fields and experiments, while to the student and the visitor it has proved to be one of the most attractive features of the farm.

The area devoted to each of the above plants varied from one to four rows, three feet apart and four rods long. These small areas and the condition under which they were cultivated render the results wholly unreliable to admit of making computations of yields per acre, but the following notes on some of the new and more promising species may convey an idea of their economic promise:

Winter Vetch (Vicia Villosa) Sown May 15.—Three rows, three feet apart, of this legume, completely covered the ground with a dense mat in full blossom at the time it was cut on October 1. It formed a complete mulch, under which the ground showed a degree of moisture far in excess of the surrounding soil. Certainly this crop, even though a single trial has showed it to be undesirable as a feed for cattle, bids fair to become a favorite crop for green manuring, since it is a nitrogen catcher and may be sown so as to attain a maximum growth at any time between June and November.

Sorghum and Kaffir Corn.—Four varieties of sorghum and two of Kaffir corn all made excellent growth, which remained, green and succulent long after the Indian corn had matured and its stalks had dried. They even rallied after the early frost, and at the date of havesting, October 15, their leaves were green and their stalks fresh and juicy. The sorghums matured their seeds, but none could be found on the Kaffir corn.

A sample of seed corn brought from Georgia made a remarkable growth, attaining a height of 14 feet, though our season was too short for it to mature.

Bodourian Corn.—A small sample of which was received from Armenia made a very promising growth, and will be tried on a large scale with pure seed another year.

Pearl Millet.—Grew to the height of nine and a half feet, averaging eight feet, and produced a prolific growth of leafy stalks, but no seeds of this plant matured. A similar growth was obtained with broom millet, which attained an average height of six feet, and produced a few perfect seeds.

Two samples of Korean millet attracted much attention by their abundant growth, which remained green the latest of all the millets in the collection. Their stems were fine, leafy and erect, attaining a height of seven feet, only a few of the seeds, however, coming to maturity.

Velvet Beans.—A few seeds of this plant from Orange county, Florida, were presented to us by Mr. H. Chambers, Lansing, Mich., and were planted on June 29. Their early development was slow, but the late fall permitted them to make a vigorous growth, which completely covered the ground with climbing vines not unlike those of the cow pea and ranging in length from five to seven feet. The seeds, however, did not mature, but the promising growth which this legume made recommends it as a substitute for the cow peas, which have proved generally unsuccessful here but have become favorite green manuring crops where they thrive. This crop will receive more attention here the coming year.

Hemp.—Grown on the Curiosity Strip attained a height of five feet and made a healthy, vigorous growth.

The following is a list of plants which failed to make a growth in any measure worthy of consideration: Esparsette, soja beans, oats and flax from Armenia, chufas, kidney vetch, teosinte, caterpillars, old man salt bush, opium poppy, Dyers' madder.

FERTILIZER EXPERIMENT.

On July 10, several sections of the State were visited by a light frost. Evidence of its visitation were seen on the muck land which was planted to corn in Field No. 13, about one acre of this field being destroyed by the frost. Accordingly, it was decided to inaugurate there some fertilizer experiments, to be the initial of a considerable work in that line, provided the results of this experiment gave promise of anything that would be valuable elsewhere under similar conditions. Eight plots, of one-tenth acre each, were measured off, twenty-two feet wide by 198 feet long, and treated as follows:

Plot No. 1—Leached ashes, five tons per acre.

Plot No. 2—Sand from the gravel pit, one inch thick.

Plot No. 3—Nothing, ordinary cultivation.

Plot No. 4—Air slaked lime, two tons per acre.

Plot No. 5—Commercial fertilizer, 400 pounds per acre.

Plot No. 6—Home-mixed fertilizer, equal in nitrogen, phosphoric acid and potash to the commercial fertilizer applied in No. 5.

Plot No. 7—Barnyard manure, ten cords per acre.

Plot No. 8—Thoroughly rolled, otherwise receiving the same cultivation as the other plots.

The materials applied were carefully harrowed in, and the following crops were sown in duplicate across the plot, the west end of the plots being duplicate of the crop sown on the east end: Crimson clover, flat turnips, corn, peas, buckwheat, rape, barley, oats, Hungarian grass, millet, radishes and cabbages. Owing to the dry weather which followed the planting of these crops and the lateness of the season at which they were sown, several of them made no growth worthy of mention. The flat turnips and the radishes made decidedly better growths on the plots manured with commercial fertilizer, home-mixed fertilizer and barnyard manure, while the crimson clover showed evidences of a preference to the plot on which sand was applied. Further notes were taken upon the growth of these plants, the turnips from each plot were weighed and several photographs taken, all of which may be published after a more thorough investigation of the experiment.

The conditions which prevail in this particular piece of land resemble so closely those or vast areas of muck land throughout the State that if any measure of success is obtained by the treatment that we may inaugurate here, further trials will probably be offered by the Station for a co operative experiment along this line in other places.

Respectfully submitted,

J. D. TOWAR,

Agriculturist.

Agricultural College, Mich., Nov. 1, 1898.

REPORT OF THE HORTICULTURIST.

Prof. C. D. Smith, Director:

Sir—I submit herewith a report of the work done by the Horticultural Department for the past year. As has been the custom in previous years, the results of such work as has been completed have been issued as bulletins, and during the coming winter several bulletins will be submitted that will give to the public the results of the work carried on during the past season.

The experiments with which the department has been occupied during the past season have related, to a considerable extent, to the testing of varieties of fruits and vegetables, as well as a large number of ornamental trees and shrubs for the lawn and greenhouses. We have also done a considerable amount of work in the way of testing insecticides, fungicides and spraying machinery, and preventing loss from insects and fungous diseases to the various crops of the garden, orchard and greenhouses. Experiments have also been continued in testing different methods of culture—pruning, training and the use of fertilizers, etc.

TESTS OF VEGETABLES.

During the spring, the novelties advertised by the various seedmen were secured and were grown so that they could be compared with many of the older kinds. While some of them seem to have merit, many of them were far inferior to the older kinds. It is evident, however, from the results secured in this, as well as in previous years, that many of the larger seedmen are taking much pains to improve the quality of the seeds that are sent out. Most of them seem to have the proper germinating power, and from year to year we have noticed less variation in the varieties, indicating that attention was being given to the selection of a good grade of stock seed. Although many of the new kinds, or at least those that have been sold under new names, resemble in a general way many of the older varieties, it is evident that in most cases they have shown some slight variation in one or more directions, which have improved their value as garden varieties. The results of the trial will be presented in a bulletin later on.

Aside from the tests of vegetables obtained from the seedmen and originators, we received from the Department of Agriculture a large number of varieties of water and musk melons, cabbages, pumpkins, etc. These have been selected by Prof. N. E. Hansen, in Russian Siberia, as promising kinds for introduction in this country. In order that the test might be sufficient to show the value of the varieties for different parts of the State, the seed was divided and distributed to some of the leading melon growers. The reports have not all been received, but it is evident from those that have come in, as well as from the tests made here, that few, if any, of the varieties will be of any value whatever. The vines were vigorous and quite productive, and perhaps are somewhat hardier than those commonly grown; but, with a few exceptions, the fruit was small and of poor, and even of a disagreeable, flavor. From these trials it is evident that none of the melons are adapted to take the place of our better varieties, and the other vegetables were quite variable in type, and in every respect inferior to the kinds we have at present. During the winter and spring a variety of vegetables were tested in the forcing house, using different methods of culture and various kinds of soil and fertilizers.

THE EXPERIMENTAL ORCHARD.

The season was quite favorable to the growing of fruit, and many of the young trees bore their first crop. The cherries and plums were especially productive, but while a fair crop was secured in the old apple orchards, comparatively few of the younger trees blossomed, and as a result but few were added to our list of tested sorts. In the fall of 1897 winter-cover crops were sown in all the orchards, and crimson clover was used quite extensively, both alone and with oats. In order to test the comparative hardiness of plants grown from seed produced in Michigan and Delaware, plots of one acre each were laid off for the comparative tests; but the season was quite favorable and little or no difference could be observed, as in neither case was there any appreciable injury from the winter. Other areas were sown at different times, to ascertain which was most favorable. The seedings made about the first of July gave the best growth before winter set in, and appeared much the strongest in the spring. Good results, however, were secured upon plots sown as late as the middle of August, although they were inferior to those earlier sown. For cherries and other fruits that ripen early, the July seeding will probably be desirable; but for the later varieties of cherries, plums and peaches, which require cultivation up to the middle of August, it will be best to delay the sowing of the seed until that time. When oats were used with the clover, even though the amount of the seed used did not exceed three pecks per acre, there was a noticeable reduction in the growth of the clover. The oats, however, made a good growth, and would have undoubtedly served to lessen the winter killing of the clover had the winter been a severe one.

When oats were used alone, at the rate of two bushels per acre, a good growth was secured, even when sown as late as the middle of August, and before winter set in many of the plants were large enough to form heads. During the winter the plants were killed and in the spring formed a sufficient mulch to prevent the baking of the soil, even where it was clay loam, although plowing was delayed until the middle of May. On the other hand, where crimson clover was used the surface was badly baked, so that on being plowed the land was quite lumpy. This seems to be the principal objection to the use of crimson clover upon a heavy soil, and it holds to an even greater degree against the use of rye as a winter-cover crop. When either of these are to be used upon stiff soils, it will be almost necessary to plow them as soon as the land is sufficiently dry in the spring, but ordinarily it will be even better to rely upon the oats as a cover crop for such soils. Oats were also used between the rows of raspberries and grapes, care being taken not to scatter the seed between the plants, and their results were quite satisfactory, as besides acting as a cover crop and furnishing humus to the soil, this crop is of value for these fruits, as it takes up the surplus water from the soil and aids in ripening the plants in the fall. In some cases, oats have been tried as a cover crop for strawberries as a substitute for the winter mulch, but the results have been less satisfactory. If sown early enough to reach a size that would make an effective mulch, the growth of the strawberry plants is checked and the crowns produced are less strong than where oats are not used. On moist, rich soil, their use will frequently be advisable, except in such parts of the State as have so mild a climate that they would not be destroyed during the winter.

INSECTS AND DISEASES.

During the year numerous letters have been received from fruit growers and others, in various parts of the State, asking regarding the nature of insects and diseases with which their crops have been troubled, and for effectual remedies against them. Although it has been confined within narrow limits, the disease that has attracted most attention and has seemed most destructive is the one that has been known as "little peach," which has been referred to in several previous reports. While it is still principally confined within two or three counties along the lake shore, its spread has been quite rapid, as, in several of the townships, thousands of trees have been destroyed. It is by most persons thought to be contagious and to be a disease that should be feared more than peach yellows. During the month of October Dr. Erwin F. Smith, of the National Department of Agriculture, the well-known expert in peach diseases, spent several weeks studying the disease in the orchards in the vicinity of Fennville and Saugatuck. He was soon convinced that it was entirely distinct from either yellows or rosette, but was unable to determine its exact nature. During the coming season we hope to be able to continue the work of testing remedies for the prevention and cure of this disease.

Many reports have been received of the injury from yellows, but in very few cases has the damage been severe in townships where attention is paid to the enforcement of the yellows law. In sections where the peach industry has been carried on extensively for a number of years, growers are well aware of the nature of this disease and of the importance of immediately destroying trees in which it has developed; but where the peach industry is a side issue, less attention is paid to it, and the disease has destroyed many trees.

IRRIGATION.

The rainfall during the past season has been so distributed that there has been but little occasion for relying upon an artificial supply of water, and it was not possible to carry on any definite experimental work. The use of water, however, upon the strawberries materially increased the yield and prolonged the season, and it also gave good results when applied upon the various late vegetable crops. As reported last year, however, the particular use of the irrigating plant has been for supplying water for spraying purposes and when necessary to transplant small fruits and vegetables during the dry period.

SPRAYING.

Aside from the regular spraying of the college orchards, various experimental tests have been made, both regarding materials and the time of application. The most marked results have been secured from experiments upon peach trees to prevent the curl leaf. As the College orchards, for the most part, contain but two trees of a variety, it has been necessary to retain one of these as a check for the application given the others. The materials tested were, first, a solution of copper sulphate at the rate of one pound in fifteen gallons of water; second, Bordeaux mixture, made from four pounds of copper sulphate and ten pounds of lime in forty gallons of water; third, a whitewash with the same amount of lime as in the Bordeaux mixture.

These materials were applied to ten trees each of as many different varieties, during the last week in March. Although the spraying was made in a thorough manner, it was impossible to reach all sides of the branches, as a strong wind was blowing, and a second application was necessary. As soon as the leaves appeared it was evident that those upon many of the unsprayed trees would be destroyed by the disease. A great difference, however, was noticed regarding the extent of the attack upon the different kinds. In some cases hardly a leaf escaped, while in others the injury was scarcely noticeable. Frequent examination of the sprayed trees, during the period in which the disease prevailed, showed that the treatment had been effectual, and that there was but little difference in the results secured from the three preparations. In a few cases, some of the sprayed trees showed a slight injury, but this could be ascribed to the fact that the buds from which the leaves came had not been properly sprayed, as in most cases the injured leaves were upon branches that extended beyond the others.

As is usually the case, the fruit dropped from the trees that were most severely injured, and there was a marked loss where no more than half of the leaves were destroyed, while upon the trees that were sprayed, the fruit remained and ripened. In order to learn if the spraying would be beneficial after the leaves had developed, a part of the unsprayed trees were treated with the three preparations above mentioned, soon after the fruit had set; but the conditions after that time were not favorable for the spread of the disease, and little benefit could be observed. It has been noticed that the disease has been most troublesome in cold, wet springs, and, although the conditions were favorable for it at the time the leaves developed, the warm weather that followed the blossoming period seemed unfavorable for the spread of the disease. In other years the greatest injury is done after the trees have blossomed, and our experiments indicate that when such is the case a spraying with Bordeaux mixture after the blossoms have fallen will do much to prevent the spread of the disease. From experiments conducted in previous years, it seems that the application of fungicides to peach trees any time after the leaves have fallen and before the first of April will suffice to prevent the attack of this disease, and as farmers and fruit growers generally have more leisure during the late fall and early winter than in the spring, we recommend that the spraying be done at that time. While a second application after the leaves have appeared may not be necessary to hold the curl leaf in check, from the fact that it will also lessen the danger from the spot diseases of the fruit and foliage, as well as brown rot, the use of Bordeaux mixture at that time is suggested. By the addition of Paris green a remedy against the curculio and leaf-eating insects will also be secured.

In order to secure a test of the effect of fungicides upon curl leaf in commercial orchards, several of the larger growers in a number of counties were urged to make use of copper sulphate solution, or Bordeaux mixture, as a remedy for this disease and to apply it early in the season. Where the suggestions were carefully followed, the very best of results were secured, and a comparison of the appearance of the sprayed trees with those unsprayed in the same and surrounding orchards, showed such a contrast in favor of spraying that no one could deny its efficiency. Even in the case of Elberta, Captain Ede and Summer Snow, which are particularly subject to attack, a full crop was secured. In several instances the fruit from young Elberta trees, that had received a single application of copper sulphate solution, brought from three to five dollars per tree, while other trees of the same variety that were older and in every way as well cared for except that they were not sprayed, not only failed to bear fruit, but were so badly injured by the disease that many of the branches were destroyed and the growth of the trees greatly checked.

In numerous instances the spraying was neglected until the buds began to open, or even until the fruit had set, and, as might be expected, the results were not satisfactory, but we have yet to learn of a single person who sprayed his orchards previous to the first of April who did not secure practical immunity from the disease.

Although little difference was noticed in the results secured from the use of copper sulphate solution, Bordeaux mixture and whitewash, for the early application we would recommend the use of the former, if to be applied in the spring, as the expense will be less than for the other materials and it is much easier to prepare and apply. In some sections where there is danger of the starting of the buds during warm periods in the fall and winter, spraying with whitewash will have a marked effect in preventing it, and will also serve as a remedy for the curl leaf, and with varieties likely to winter-kill, especially if they are grown upon a southern slope, it will perhaps be preferable to copper sulphate solution. To have it effectual, however, it will need to be used very thoroughly, and if at any time the whitewash has become washed from the trees so as to show the dark-colored bark beneath, the application should be repeated, as its efficiency results from the fact that a tree coated with whitewash will be of a lower temperature than those where the bark is exposed.

Among the other remedies that were tested was kerosene alone, and a mixture of kerosene and water, applied with an atomizer as remedies against scale insects. The use of kerosene, in either way, seems to be more effectual than when used as an emulsion, and when properly applied the mixture of kerosene and water is, if anything, less injurious to the foliage than when a similar proportion of kerosene is used in an emulsion. As a remedy against plant lice and scale insects, kerosene and water at the rate of one pound of kerosene to from four to fifteen of water, according to the nature of the insect, will be found safe to use upon the trees and rather more effectual than kerosene emulsion, or whale-oil soap. When pure kerosene is used, the amount required will be much less than will be needed with any other preparation, but care must be taken to use no more than will be necessary to reach all parts of the plants. If a larger amount is used, there will be danger of the oil running down the trunk and branches and injuring if not destroying the plant. As the peach seems particularly subject to injury from the use of this material, we would advise against its use upon that plant, but upon the other fruits it can be used with safety, if the application is made upon sunny days after the sap has commenced to rise in the spring. If used during the winter, while the bark and wood are comparatively dry, the danger will be increased. While good results can be secured from kerosene applied with small atomizers, if it is to be used in water, it will be advisable to make the application with some of the pumps that have been devised for the purpose.

FERTILIZER EXPERIMENTS.

The work of testing the relative merits of different fertilizers and their value as compared with that of stable manure has been continued, although on a smaller scale than in previous years. In some instances the results have justified the expense, as the increased value of the product was more than sufficient to pay for the cost of the fertilizer, but in no instance was an increased yield obtained from the use of fertilizers as cheaply as with stable manure. Several experiments were tried in which chemical fertilizers in various combinations were placed upon land that had been treated with stable manure the previous year, but with a variety of crops the benefits secured from the use of the fertilizer were comparatively small. In some cases the yield was no more than where no fertilizer was used, and in others the gain was but slight. In the spring of 1898, sections of the lawn upon the College campus were treated with wood ashes and various combinations of mineral manures. The season was quite favorable for the growth of the grass, and the unfertilized lawn appeared to be in rather better condition than usual, but marked benefits were noticed where the wood ashes were used at the rate of fifty bushels per acre. Upon the plots fertilized with wood ashes and ground bone, the results during the entire season were even better than where the ashes alone were used, and the results from ground bone alone, used at the rate of three hundred pounds per acre, compared favorably with those where fifty bushels of wood ashes were used, especially upon clay soil. Where sodium nitrate was used alone (150 pounds per acre), the appearance of the lawn in the spring was much better than where it was unfertilized, and the grass made an earlier growth and was of a richer color for the first month or so than upon the plots where ground bone and wood ashes were used; but, later on, the benefit was hardly noticeable where the sodium nitrate alone was used, but where combined with ground bone and wood ashes the plots retained their superiority throughout the season. Other sections were treated with potash salts at the rate of two hundred pounds per acre, both alone and combined with sodium nitrate and ground bone. The results secured were practically the same as where wood ashes were used. Where wood ashes can be cheaply obtained they will form a desirable fertilizer for the lawn, if used in quantities at the rate of twenty-five to fifty bushels per acre; and with the addition of fifty to one hundred pounds of sodium nitrate, especially if the soil is light and the grass thin, it will form a valuable fertilizer. Upon the heavier soils there seems to be less need of potash, and ground bone will often give better results, although where the price of ashes does not exceed ten cents per bushel, it may be cheaper to use an excess of ashes and thus provide the required amount of phosphoric acid.

SOUTH HAVEN SUB-STATION.

The work of testing fruit and the various methods of handling the trees, as well as insecticides and fungicides, that has been carried on in previous years at the South Haven Sub-Station has been continued during the past year under the supervision of T. T. Lyon. Although the season has been fairly favorable, the results have not been as satisfactory as in previous years, so far at least as the orchard fruits are concerned, as comparatively few of the apple trees blossomed and the crop of plums upon most varieties was also light. Quite a number of the new varieties of peaches, however, were in fruit, as were many of the grapes, cherries and pears. Full notes upon the varieties that fruited during the year will be published in a bulletin. In the spraying experiments, as was the case at the College, the results secured from the treatment of the curl leaf were particularly noticeable and agreed well with what has been stated above. As, in one respect, the experiments differed somewhat from those carried on at the College, it may be well to refer to them here.

The practical difference arose from the fact that while some of the trees were sprayed during the last week in March, others were treated four weeks later, or just as the buds were opening. The effect of the early spraying was to almost entirely prevent the disease, while the trees sprayed as the buds were swelling were considerably injured—so much so that fully one-half of the leaves of some varieties were destroyed, and this resulted in a loss of much of the crop. In previous years we have recommended to spray the trees before the buds started, but from this experiment it is evident that unless the application is made considerably before the opening of the buds the best results cannot be secured.

The sub-station has been in the hands of Mr. Lyon for ten years, and during that time he has, at the end of each season, submitted a report of his operations with full notes upon each of the varieties under test. The bulletins have had a wide circulation and have met with much favor from the fruit growers, who recognize his ability as a pomologist and place implicit confidence in the results reported by him. Owing to failing health Mr. Lyon has thought it best to give up the work, and has presented his resignation, to take effect at the close of the year. While it is doubtful if we secure the services of any one who can fill his place, the importance of the fruit testing station upon the lake shore to the fruit growers of that section make it desirable that the station be maintained in its present efficiency.

EXHIBITION OF PRODUCTS.

At the State Fair, held in Grand Rapids in September, the Horticultural Department made an exhibit of fruit grown at the College, as well as a large number of varieties from South Haven. In the latter exhibit there were a large number of peaches of new varieties, which were examined with much interest by many fruit growers, as they seemed to have considerable merit. In addition to caring for the exhibits, Mr. Dean and myself acted as judges in the fruit department.

ASSISTANTS

During the past year no change has taken place in the assistants in this department. Mr. H. P. Gladden, the first assistant, who has nearly completed his ninth year in that capacity, and Mr. M. L. Dean, who is now in his third year of service, have had charge of the growing of most of the experimental crops, and have taken most of the notes and have prepared reports of their experiments for publication.

Respectfully submitted,
L. R. TAFT,
Horticulturist.

AGRICULTURAL COLLEGE, MICH., NOV. 30, 1898.

REPORT OF THE CHEMIST.

Prof. C. D. Smith, Director:

I submit my report for the year ending June 30, 1898.

WORK IN THE CHEMICAL LABORATORY.

1. *Sugar Beets.* The most important work undertaken at the Chemical Department of the Experiment Station was on the composition and manufacturing value of sugar beets raised in the different counties of our State. This work was undertaken in collaboration with the Farm Department of this college. The importance of this investigation becomes manifest when we consider that it laid the foundation for a new and profitable industry in our State, giving employment to a large amount of capital, afforded a new outlet for labor and gave the farmer a new cash crop and diversified industry on the farm. It demonstrated that Michigan stands at the front in the capacity to produce sugar for its own people and even other States.

The amount of work involved in this investigation is evident when it required the analysis of 500 samples of sugar beets. The results of a year's work on this subject were given in Bulletin No. 150, which has been in large demand among the farmers of this State, and may be called the Farmer's Text Book on Sugar Beets.

2. *Analysis of Commercial Fertilizers.* The law requires the analysis of all commercial fertilizers whose retail price exceeds $10 per ton. In compliance with this law 73 samples of such fertilizers were gathered in the open market from dealers having them on sale, and carefully analyzed in this laboratory, and the results given to the public in Bulletin No. 161.

The value of these fertilizer bulletins in giving farmers and gardeners some guarantee of the purity of the materials as well as a basis for computing their money value is shown by the demand for the bulletin.

3. *Analysis of drainage water.* Analysis of 15 samples of drainage water was made to find how much of fertility was carried off from a cultivated field by subsoil drains.

4. *Analysis of fodders, etc.* Sixteen samples of fodders, ensilage, etc., have been made to determine the food value of different materials, and how this is modified by different modes of treatment.

5. *Miscellaneous analyses.* A large number of analyses have been made, such as 7 of water, 6 of butter, 5 of milk, 5 of roots, 4 of honey, 3 of ashes, 2 of pollen and 2 of muck.

These analyses were made by L. S. Munson, B. S., the efficient Chemical Assistant in the Experiment Station.

Respectfully submitted,

R. C. KEDZIE,
Professor Chemistry.
F. S. KEDZIE,
Adjunct Professor.

June 30, 1898.

REPORT OF THE BACTERIOLOGIST.

Director C. D. Smith:

Dear Sir—The work in bacteriolgy from November 1, 1897, to November 1, 1898, has covered a wide field. With the exception of tuberculosis, all of the experiments which will be included in this report were begun since November 1, 1897, and in large part are in progress at the present time. However, we anticipate concluding some of the work in the near future and getting it ready for the press. One experiment was concluded several months ago, but, owing to the crowding of laboratory work, I have been unable to get it ready, together with a didactic bulletin which I wish to issue at the same time.

The laboratory experimental work may be designated by the following heads: "Tuberculosis," "Crown Gall," "Gassy Cheese," "Hog Cholera," "Cleanliness in Handling Milk."

TUBERCULOSIS.

The experiments involved in the investigation of this disease are varied.

Tuberculin Tests.—During the past year a bulletin has been issued on the results obtained from the tuberculin tests of the College herd. When we first took up the work, it was our purpose to study carefully the reliability of the tuberculin test as it is commonly applied. To accomplish this, an extensive study of normal temperatures was essential, that a correct judgment might be formed from the comparison. The normal temperatures were taken in precisely the same manner as in the tuberculin test. In the test of last spring it was found that had these extra normals not been taken nine animals would have been liable to condemnation, whereas only one was condemned. These nine animals which showed peculiar temperatures were again tested this fall, but they without exception proved to be all right. We hope to follow up this tuberculin work until the evidence will be so definite and convincing that there will be no possibility of error of interpretation.

Milk from Tuberculous Cows.—We have not yet detected any infectiousness from milk taken from the condemned animals, although tests have been made at different times. It is our plan now to feed the milk to pigs and calves for the purpose of demonstrating an infectiousness. If no infectiousness exists these animals may be put upon the market as sound. subject to inspection by us when killed. In this way we shall be able to realize something from these animals and still have them under our supervision. Aside from this work, we hope to test for tubercle bacilli numerous samples of milk and butter, perhaps cheese also, gathered from different parts of the State. My object in so doing is to form some idea of the prevalence of tuberculous milk, butter and cheese. This, I think should be done before any publication treating of tuberculous milk is distributed.

Urine and Feces.—These substances are receiving their attention. At present there are some experiments under way which we are in hopes will give us some light on the true possibility of infection from manure. Owing to the presence of Septicæmic germs in the manure, work which was begun one year ago has been rendered *nil.* This is one of the serious obstacles a bacteriologist has to contend with. We have begun again, but this time, from necessity, treating the manure to a sterilizing process and then artificially inoculating it. This, of course, is not the natural method, but it answers as a good substitute.

Curative Treatment.—We are now watching the condemned animals at our disposal with the expectation that some of them will recover under proper hygienic treatment. This experiment is not far enough advanced to base any claims upon it. As to other curative treatments, the one begun by Prof. Grange was found worthless, and several begun by myself —first upon small animals, for these animals we are able to study and watch carefully—have proved likewise worthless. This is a repetition of what has been going on for eighteen years. As to the serum treatment which is being tried in several parts of the world, it will probably prove very valuable in time for the treatment of human tuberculosis, but will be too expensive for bovine tuberculosis for years to come. There is no means of determining what the outcome of it will be. I have not attempted it here, because of the extra expense it would involve, not only in money but in time, which I have not at my disposal.

Eradication of Tuberculosis from College Herd.—The result of the tuberculin test of last spring places us in a very hopeful situation, but we must not be so elated as to forget that the next annual test may show a very different state of affairs.

If carelessness and indifference are going to be the product of a temporarily successful issue, it were better that several animals had responded instead of one. There will be no preparation for an adverse situation due to neglect. Under no circumstances should the animal tuberculin test be omitted, or should disinfection be regarded as useless. If one pure-bred cow is saved by disinfection, it not only pays directly for the work and material, but indirectly checks the propagation of the disease. The best sanitary regulations should also be enforced, for as long as the disease is prevalent, or the germ is at large, any indisposition of an animal may lead to tuberculosis. The vigor and strength of an animal must appeal to the mind in the same light as the vigor and strength of man, if the greatest usefulness is to be attained.

CROWN GALL IN PEACHES.

Experimental work with the disease known as crown gall in peaches was instigated and placed under my charge in November of 1897, by the director of the Station, with the understanding that I was to do what I could in discovering the cause of this disease, working under the assumption that it is bacterial in nature. This was done with the full knowledge that competent workers had been trying for years to ascertain the cause but had not yet been able to discover it, and that years of work might not lead to any more light on the etiology of the disease.

It was my request that I repair to a locality where this disease was prevailing, and there carry on my experiments and observations.

Through Prof. Hedrick, then State Nursery Inspector, Mr. Alex Hamilton, of Bangor, Mich., offered to allow experiments to be conducted at his nursery and to help us if it were in his power. Mr. Hamilton has been very accommodating in giving the use of his land, time and labor, and also trees.

There were during the year about 700 trees in the experiments of various kinds. Some of the trees were planted November 4, 1897, and the remainder April 20, 1898. This fall we pulled some of the experimental trees and found results which, although not well defined, offered sufficient encouragement to act as a stimulus, where we scarcely expected to find anything. The remainder of the trees will not be pulled till a year from this fall. Prof. Wheeler advises extending the experiment further if Mr. Hamilton will consent, and pursuing it even to the bitter end, if it takes several years. This is really the only way we can arrive at any conclusion. We hope that next fall, when the remainder of the planted trees are pulled, the results will help us another step on the way. I agree with Prof. Wheeler, whose judgment in the study of plant diseases I accept in preference to any conclusions I may hastily form from insufficient data regarding plant life.

GASSY CHEESE.

Last winter, during the cheese course, there occurred an off fermentation which made the curd gassy and sponge-like. Some of the curd was taken and the germ causing the trouble isolated. During the year this germ has been studied, and once used as a starter in cheese making. It produces spongy cheese. Owing to the fact that no cheese is made at the College, except during the cheese course, the extended study of its action in the manufacture of cheese has been postponed till December, at which time, in conjunction with Mr. True, I hope to ascertain its economical bearing. This is the most common trouble cheese makers have to contend with.

SUSPECTED HOG CHOLERA.

Last June an epidemic broke out among the younger pigs on the College farm, and was pronounced hog cholera by the veterinarians. Every symptom indicated that it was hog cholera or a disease closely allied to it. Upon the post-mortem of several of these pigs, there were lacking some of the lesions which are usually found in hog cholera. At the request of the director of the Station, an attempt was made to find the germ of hog cholera. Usually this germ is found without much difficulty. However, in these cases, culture after culture was made from the various organs of thirteen or fourteen of the animals that died or were killed for the purpose, but no trace of the hog cholera germ could be found. All the cultures which were made remained sterile with the exception of a fraction of one per cent, which showed the presence of saproyhtic germs, due to the incipient stage of putrefaction. Having studied bacteriologically the animals sick on the College farm, and not having found a trace of the hog cholera germ, it was thought expedient to extend the study to epidemics among hogs about the State and within easy reach of the College, to ascertain whether the epidemics were due to the true hog cholera bacillus or some other contagious element. In every case the disease was called hog cholera. Examinations and investigations were made in the vicinity of Jackson, Otsego, Delta and Hudson, and in each instance we have been unable to discover the presence of the hog cholera bacillus. Pathogenic germs have been found in the intestines, where were located the primary lesions, yet in no instance have we been able to establish the relation of the germs found to the disease, unless those which are under observation at the present time should act differently. This is due to the fact, largely, that the germs isolated would generally lose their virulence from artificial culture before it could be determined that they have any relation to the disease. Bacteriologic technique has not been able to overcome the difficulty arising in changing germs from natural surroundings to artificial surroundings, and this may be the reason we do not find the germ that is at the foundation of the trouble.

Moore of the Cornell Station, New York, has given this subject a great deal of attention for the past few years, and has tentatively concluded that a large per cent of suspected hog cholera about the eastern states is not the true hog cholera at all, but is due to some local surroundings. So far, he has been unable to isolate the germ or germs causing them. These epidemics seem to spring up, run a course of two or three months, then die out, and are not so persistent as true hog cholera. In cases of hog cholera, it is unsafe to turn pigs into the same lot for two or three years after the epidemic; but in these epidemics, after the course has been run, hogs are turned into the infected lots with total indifference. While the mortality may be nearly as great in any herd affected as in true hog cholera, the danger or the seriousness of the case cannot compare with it. Consequently, it is well that the farmer know whether he has true hog cholera or summer complaint, caused by improper food or water, among his hogs—whether we are able to determine the exact cause of this complaint or not. Summer diarrheas of a choleraic nature, which are so common among human beings and which are due to different germs and no specific germ, give symptoms which are almost indentical. These may give us a clue, reasoning from analogy, to the real nature of the local epidemics among swine.

CLEANLINESS IN MILKING.

Work is under way to demonstrate the great need of cleanliness in handling milk. No one appreciates, or can appreciate, the actual filth of milk until he has studied it bacteriologically. It is our purpose to begin with the milking process, and eliminate, so far as it is possible and practicable, the filth that gets into the milk. It is believed that a greater share of it may be eliminated if a few percautions are taken. This of course, will increase the trouble and work entailed in milking—but it will eradicate nearly all the diseases which milk is heir to, and will make milk palatable to those who know what filth gets into milk during the ordinary methods of milking.

Very respectfully submitted,
CHARLES E. MARSHALL,
Bacteriologist.

LABORATORY OF BACTERIOLOGY AND FARM HYGIENE, November 11, 1898.

REPORT OF THE APIARIST.

Prof. C. D. Smith, Director:

Sir—The following is the report of the work done in the Apiary for the year from November 1, 1897, to November 1, 1898.

The bees were put into winter quarters November 27, 1897—twenty-five swarms in all. They were wintered in the cellar, and by constant attention the temperature was kept between 44° and 48° F. The cellar was not the best, and the bees were uneasy part of the time.

One swarm was killed by the rats, but the most of the remaining twenty-four came through in good condition. A few cases of dysentery were carefully fed, and, although weak, survived.

The bees were all taken out of the cellar April 11, 1898, and placed on the summer stands with a chaff cushion over the frames for protection.

One colony, supposed to be innoculated with bee-paralysis from a southern apiary, was carefully watched all the season, and has shown no traces of the disease. (See Board Report for 1897.) It is now as healthy as any colony, and will be put into winter quarters with the rest of the bees. The experiment will be discontinued, as we seem to be unable to produce the disease here at Lansing. It should be experimented on in the southern states, where it is at home.

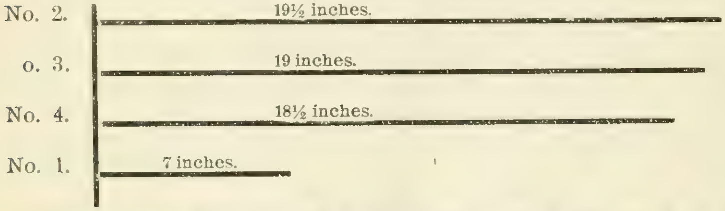
A course in bee-keeping was given to the Agricultural freshmen in the spring term, and 76 of them took the two weeks course. This covered a few of the principal points in the management of bees. Four colonies in box hives were bought and transferred by the students for the purpose of giving them some practical work along this line. The other work consisted of queen rearing, introducing queens, hiving swarms, etc., as well as handling the different kinds of apparatus connected with an apiary including nailing-up different kinds of hives.

An experiment was made with some of the different kinds of foundations. Plain sections were used in this experiment, and thirty sections were filled with each kind of foundation. It was put in the sections in double starters. The sections were arranged through the supers in different ways. Some were alternately arranged and some were in rows. One super was put on a good, strong colony when the honey flow was at its best and in three days it was removed and the results noted. The other supers were left on the hives until the close of the harvest, but owing to the very limited flow these results were not entirely satisfactory. A foundation that was torn down under this experiment might be the most readily accepted by the bees in a good year. The kinds of foundation were No. 1, Root's XXX or 18 feet to the pound; No. 2, Root's Extra Thin Surplus; No. 3, Dadant's Extra Thin Surplus; No. 4, the "No Wall," made by Dadant.

The following is a table showing their relative weights:

Thirty sections filled with double starters. Kind of foundation designated by number.	Wt. when put on.	Wt. when taken off.	Gain.	Per cent wax.
No. 1	1.51	12.01	10.59	4.42
No. 2	1.64	19.25	17.61	3.64
No. 3	1.63	18.50	16.78	4.37
No. 4	1.60	16.80	15.20	4.70

In the super left on the hive only three days the relative lengths of the starters left in the sections is shown as follows:



This shows that the 18 feet to the pound (No. 1) was nearly all torn down while the other kinds were cut out but little. The foundation did not fall out of a single section. The bees simply began at the bottom and gnawed it off. It is a very delicate article, but for some reason the bees object to it. The per cent. of wax in the combs built on this foundation, was greater than that built on the ordinary thin surplus.

The No Wall foundation, was invented by Mr. Bingham, of Farwell, and is manufactured by Dadant. It is a very light foundation, and as its name suggests, has no sidewall to the cells. It is simply a light foundation with just the impression of the bases of the cells. The bees accepted this foundation readily and worked on it well, but for some reason they built brace combs from the sections to the fences quite freely and when the sections were taken out of the super these brace combs scalped patches of honey. This was its worst feature and further experiments will be made with it next season.

Root's extra thin surplus is a foundation that needs no description, as every one is acquainted with it. It was filled better than the other varieties and contained a smaller per cent. of wax than the combs built from any other variety.

Dadant's extra thin stood next to Root's in the test. The bees readily accepted both of these varieties and seemed to show no preference whatever, but at the end of the test the sections filled with Dadant foundation did not weigh as well and contained a greater per cent. of wax than those filled with Root's. These foundations are so very similar and the results so near the same that it would be impossible to say that under all circumstances one would be better than the other.

In this entire experiment full sheets of foundation on the double starter plan were used.

It seems strange that there should be a larger per cent. of wax in a comb built from a light foundation than from a heavy one, but such was the case.

One or two experiments, however, cannot prove conclusively the merits or demerits of any one kind of foundation. As has already been said the results under different conditions, might have been very different. A similar experiment will be made next year.

An experiment was made to determine the advantages and possible disadvantages of the plain section. As it has been offered for sale by the principal supply dealers for two seasons a description is unnecessary. See Bee-Keeper's Review for January, 1898, also American Bee-Keeper for December, 1898.

Several supers were fitted with plain sections on one side and open top on the other. In every case the bees began on the plain sections first and they weighed the heavier, section for section. Of course it is to be remembered that the flow was light and in a heavy flow the open top and bottom would doubtless outweigh the plain when they were properly filled. The fence separators are easily adjusted and the plain sections are more easily cleaned, pack closer in the crate and look very much better on the market. The combs selected were a fair sample and it will be readily seen that the plain ones are the most attractive. They are an improvement and have many advantages over the old style.

Less than a mile north of the College Apiary is a large marsh of nearly 8,000 acres. This marsh is nearly five miles long and is rich in boneset, wild bergamot, willow-leafed spirea, coreopsis and goldenrod. The bees in the yard worked on these flowers quite freely and August 1, eight colonies of equal strength, were weighed up and four of them were moved three miles north into the center of the marsh. These four were returned to the yard October 7, after the honey flora had been killed by the frosts. The weights were as follows:

Weight of four colonies left at home, 278 pounds, average 69½ pounds each.

Weight of four colonies taken to the marsh, 268 pounds, average 67 pounds each.

Total gain of those left at home in 68 days, 35 pounds, average 8 3-4 pounds each.

Total gain of those taken to marsh, 156 pounds, average 39 pounds each.

Total gain of the four colonies taken to the marsh over those left at home was 121 pounds, average 30¼ pounds each. These colonies were in better condition than those left at home.

Besides this, owing to the fact that they were so far away, constant attention was impossible and two of the colonies swarmed. This weakened them so much that nearly all the gain was made by the two colonies that did not swarm.

This experiment clearly demonstrates the fact that although bees will fly a long distance after honey, when they are moved directly to the flora they will store much more nectar than if compelled to fly to it and bring it back a drop at a time. The honey gathered at the home yard and in the marsh was identically the same during this period, so the bees were undoubtedly all working on the same field.

The continued experiment on bees' tongues did not make such marked progress as it did last year. At the beginning of this season the longest tongues in the yard measured 5.41 m. m.

One direct cross was made, but owing to the large number of drones from common stock in the surrounding country, no other queens were satisfactorily mated. The bees from this cross have made a gain of .9 m. m., and now measure 6.31 m. m. The experiment will be continued.

The year has been a poor one for the apiculturist in this section, The abundance of white clover seemed to yield no nectar at all and the most of the surplus was from autumn flowers. Many apiaries in this vicinity gave no surplus at all.

During the year I have visited almost all the apiaries near here, attended and read a paper at the State Bee-Keepers' Association and was elected treasurer of the same. In June I attended the Horticulturists' meeting at Muskegon, and read a paper on The Relation of Bees and Horticulture.

Respectfully submitted,
J. M. RANKIN,
Apiarist.

SUMMARY OF METEOROLOGICAL OBSERVATIONS AT THE MICHIGAN AGRICULTURAL EXPERIMENT STATION FOR THE YEAR 1897.

IN CONTINUATION OF THE SAME SERIES OF OBSERVATIONS RECORDED FOR THE MICHIGAN AGRICULTURAL COLLEGE SINCE 1863.

BY R. C. KEDZIE, PROFESSOR OF CHEMISTRY AND CHEMIST OF THE STATION.

Months, 1897.	Mean daily temperature in open air.	Percentage of humidity saturation—100.	Pressure of vapor of water.	Height of barometer reduced to 32° F.	Percentage of cloudiness.	Amount of rain or melted snow in inches.	Snowfall in inches.	Number of thunder storms.
January	22.34	97	.136	29.124	73	4.17	11¼	1
February	26.38	97	.146	29.090	80	0.67	10⅝	0
March	33.00	94	.190	29.085	65	2.64	10½	0
April	44.58	90	.282	29.143	65	2.74	1	2
May	55.83	88	.407	29.058	52	3.75	0	2
June	64.21	88	.562	29.050	52	2.57	0	3
July	73.79	88	.743	29.017	32	8.49	0	5
August	65.94	88	.566	29.066	29	1.69	0	2
September	62.92	87	.535	29.267	19	0.80	0	0
October	53.06	88	.375	29.227	30	2.15	0	1
November	36.49	89	.204	29.154	63	2.94	1	0
December	25.62	96	.148	29.095	72	2.02	5	0
The year	47.01	91	.358	29.115	53	34.63	39⅜	16

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	41	49	51	47	100	100	100	.257	.348	.374	29.264	29.248	29.249	29.254
2	53	52	50	51⅔	100	100	100	.403	.388	.361	29.215	29.168	29.218	29.200
3	52	53	42	49	100	100	100	.388	.403	.267	29.267	29.259	29.110	29.212
4	34	25	26	28⅓	100	100	100	.195	.135	.141	28.8 0	28.840	28.811	28.824
5	16	22	15	17⅔	100	100	100	.090	.118	.086	28.759	28.730	28.856	28.782
6	20	22	16	19⅓	100	100	65	.108	.118	.059	28.992	29.030	29.118	29.047
7	15	26	21	20⅔	82	100	100	.070	.141	.113	29.239	29.209	29.256	29.235
8	12	30	18	20	80	78	84	.060	.130	.082	29.360	29.329	29.326	29.338
9	31	39	28	32⅔	89	100	100	.155	.238	.153	29.001	29.042	29.044	29.031
10	29	32	26	29	77	100	100	.123	.181	.141	29.050	28.989	28.964	29.001
11	23	27	22	24	100	100	100	.123	.147	.118	28.929	28.974	29.046	28.983
12	15	21	13	16⅓	100	100	100	.086	.113	.078	29.544	29.295	29.289	29.276
13	20	26	22	22⅔	100	100	100	.108	.141	.118	29.186	29.108	29 121	29.138
14	22	30	18	23⅓	100	67	84	.118	.111	.082	29.204	29.232	29.256	29.231
15	22	29	31	27⅓	86	88	100	.101	.142	.174	29.251	29.155	29.110	29.172
16	31	34	32	32⅓	89	100	100	.155	.196	.181	29.121	29.040	28.988	29.050
17	41	47	30	39⅓	100	100	100	.257	.323	.167	28.456	28.369	28.380	28.402
18	19	19	13	17	100	100	81	.103	.103	.064	29.064	29.213	29.297	29.191
19	8	17	18	14⅓	100	67	100	.062	.063	.098	29.451	29.445	29.237	29.378
20	26	35	31	30⅔	100	100	100	.141	.204	.174	29.046	28.915	28.721	28.894
21	28	30	23	27	100	100	100	.153	.167	.123	28.810	28.859	28.899	28.856
22	33	19	14	22	100	100	100	.188	.103	.082	28.944	28.950	28.9·0	28.958
23	11	17	7	11⅔	100	100	100	.071	.094	.060	29.188	29.094	29.141	29.141
24	-6	4	-15	-5⅔	100	100	100	.033	.052	.032	29.150	29.183	29.215	29.183
25	-13	4	-3	-4	100	100	100	.025	.052	.038	29.220	29.171	29.215	29.202
26	-2	10	6	4⅔	100	100	100	.040	.068	.057	29.202	29.185	29.137	29 175
27	2	13	7	7⅓	100	100	100	.048	.078	.060	29.047	28.974	28.974	28.998
28	7	21	14	14	100	100	100	.060	.113	.082	28.952	29.044	29.199	29.065
29	14	25	15	18	100	100	100	.082	.135	.086	29.290	29.403	29.440	29.378
30	18	31	7	18⅔	100	89	100	.098	.155	.060	29.593	29.599	29.611	29.601
31	6	31	12	16⅓	100	89	100	.057	.155	.075	29.671	29.651	29.649	29.657
Sums														
Means				22.34	97	96	97	.128	.159	.122				29.124
Average					97			.136						

January 17, thunder storm and violent fall of warm rain.

JANUARY, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Nim.	100	Nim.	100	Nim.	s e	10	s	9	s	8	53	42	*8 p. m.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s	8	s	10	s w	11	54	49	Cont.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s e	13	s e	10	s w	19	54	34	Cont.	--------	------	------
100	Nim.	100	Nim.	--	--------	s w	10	s w	16	s w	9	34	16	†	7 a. m.	2.57	------
100	Nim.	100	Nim.	50	Str.	s w	9	s w	12	s w	14	22	13	‡	--------	------	------
80	Nim.	80	Nim.	80	Str. Nim.	w	9	w	13	s w	8	24	14	‖10 a m	¶	.06	2
100	Nim.	80	Cu.	----	--------	s w	5	s	5	s	3	28	11	--------	--------	------	------
----	--------	----	--------	----	--------	e	1	s e	2	----	0	35	12	--------	--------	------	------
20	Cir.Str.	50	Cu.	100	Cu.	s w	9	s w	16	s w	8	39	27	--------	--------	------	------
90	Cu.	80	Cu.	100	Nim.	s w	6	s w	10	s w	2	34	22	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	----	0	s w	10	s w	2	28	15	‡	3 p. m.	.01	½
100	Nim.	100	Nim.	----	--------	n w	2	----	0	----	0	22	12	‖	**	------	------
100	Nim.	100	Nim.	20	Cir.	s e	7	s e	7	s e	4	26	19	‖7 a. m.	**	------	------
100	Nim.	50	Cir.	----	--------	n e	2	e	2	----	0	30	12	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	1	s w	7	s w	12	31	20	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	6	s w	5	s w	13	41	31	*5:30pm	--------	------	------
100	Nim.	90	Nim.	100	Nim.	s w	13	s w	18	s w	13	47	19	3 p. m.	††	.65	------
100	Nim.	70	Cu.	20	Cir.	n w	8	n w	13	n w	6	19	8	§	8 a. m.	.11	½
100	Nim.	80	Cu.	10	Cu.	n e	3	s e	2	s e	10	25	9	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	7	s	6	----	0	36	25	‖3 p. m.	11 p. m.	.30	4
100	Nim.	100	Nim.	100	Nim.	w	5	s w	9	s w	7	32	21	‖8 a. m.	Night	.07	½
100	Nim.	100	Nim.	100	Nim.	----	0	n w	12	n w	15	33	8	*7:30am	8 a. m.	------	‡‡
100	Nim.	30	Cir.	15	Cir.	n w	8	n w	7	n w	4	17	-8	‖	**	------	------
20	Cir.	40	Cir.	----	--------	n w	4	n w	12	w	1	4	-17	--------	--------	------	------
----	--------	100	Nim.	----	--------	s w	1	s w	10	s w	5	5	-8	--------	--------	------	------
100	Nim.	100	Nim.	----	--------	s w	5	s w	9	s w	6	12	-2	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	3	s w	5	s w	8	15	-1	‖8:30am	Cont.	------	------
100	Nim.	100	Nim.	100	Nim.	s w	4	w	8	w	2	27	7	Cont.	--------	------	------
100	Nim.	100	Nim.	100	Nim.	----	0	s w	2	s w	5	26	14	Cont.	--------	------	------
100	Nim.	----	--------	----	--------	s w	2	s w	3	s e	3	32	-2	Cont.	10 a. m.	.40	4
----	--------	50	Cir.	----	--------	s e	3	s e	5	s e	3	31	-1	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	4.17	11½
84	--------	81	--------	55	--------	----	----	----	----	----	----	29.55	13.58	--------	--------	------	------
73						----	----	----	----	----	----	------	------	--------	--------	------	------

* Rain.
† Continued, snow 9 a. m.
‡ Snow, morning.
‖ Snow.
§ snow 7:45 a m.

¶ Morning flurries.
** Snow flurries.
†† Noon, 5 p. m.
‡‡ Trace.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	0	32	26	19⅓	100	100	100	.044	.181	.141	29.423	29.270	29.180	29.291
2	24	34	29	29	100	100	100	.129	.196	.160	29.119	29 100	29.193	29.137
3	24	30	24	26	100	100	100	.129	.167	.129	29.168	29.170	29.218	29.185
4	26	32	24	27⅓	100	100	100	.141	.181	.129	29.244	29.218	29.157	29.206
5	26	35	30	30⅓	100	100	100	.141	.204	.167	29.164	29.083	28.819	29.022
6	34	37	34	35	100	100	100	.196	.221	.196	28.746	28.786	28.843	28.792
7	32	32	31	31⅔	100	100	100	.181	.181	.174	28.983	28.986	29.063	29.011
8	29	30	29	29⅓	100	100	100	.160	.167	.160	29.035	29.072	29.153	29.087
9	29	31	28	29⅓	100	89	88	.160	.155	.135	29.247	29.253	29.301	29.267
10	26	32	24	27⅓	100	89	100	.141	.162	.129	29.327	29.267	29.265	29.286
11	22	26	22	23⅓	86	100	100	.101	.141	.118	29.229	29.114	28.854	29.066
12	20	31	24	25	100	89	86	.108	.155	.111	28.754	28.896	29.069	28.906
13	21	28	23	24	100	100	100	.113	.153	.123	29.148	28.996	28.936	29.027
14	24	36	26	28⅔	86	100	100	.111	.212	.141	29.009	29.074	29.104	29.063
15	24	36	25	28⅓	100	100	100	.129	.212	.135	28.954	28.908	28.885	28.916
16	27	37	36	33⅓	100	100	100	.147	.221	.212	28.870	28.830	28.762	28.821
17	33	45	30	36	89	84	100	.168	.251	.167	28.740	28.740	28.996	28.815
18	20	35	18	24⅓	85	90	100	.091	.183	.098	29.121	29.202	29.293	29.205
19	10	40	29	26⅓	100	100	100	.068	.248	.160	29.393	29.394	29.334	29.374
20	32	33	32	32⅓	100	100	100	.181	.188	.181	29.039	28.377	28.490	28.635
21	31	35	30	32	100	100	100	.174	.204	.167	28.939	28.969	28.995	28.968
22	35	38	30	34⅓	100	100	100	.204	.229	.167	28.855	28.660	28.739	28.751
23	26	35	16	25⅔	87	100	100	.123	.204	.090	28.928	29.019	29.085	29.011
24	10	28	26	21⅓	100	76	100	.068	.117	.141	29.219	29.104	29.024	29.116
25	16	26	10	17⅓	83	100	100	.074	.141	.068	29.210	29.218	29.307	29.245
26	11	16	4	10⅓	79	100	100	.057	.090	.052	29.269	29.265	29.461	29.332
27	7	16	20	14⅓	100	100	100	.060	.090	.108	29.443	29.427	29.447	29.439
28	20	20	11	17	100	100	100	.108	.108	.071	29.486	29.600	29.590	29.559
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	26.38	96	97	99	.125	.177	.137	--------	--------	--------	29.090
Average	------	------	------	------	97.			.146			--------	--------	--------	--------

FEBRUARY, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds. 7 A. M. Per cent of cloud.	Clouds. 7 A. M. Kind.	Clouds. 2 P. M. Per cent of cloud.	Clouds. 2 P. M. Kind.	Clouds. 9 P. M. Per cent of cloud.	Clouds. 9 P. M. Kind.	Winds. 7 A. M. Direction.	Winds. 7 A. M. Force.	Winds. 2 P. M. Direction.	Winds. 2 P. M. Force.	Winds. 9 P. M. Direction.	Winds. 9 P. M. Force.	Registering thermom'r. Maximum.	Registering thermom'r. Minimum.	Rain and snow. Beginning rain or snow.	Rain and snow. Ending rain or snow.	Rain and snow. Inches of rain or melted snow.	Rain and snow. Depth of snow, inches.
50	Cir.	100	Nim.	100	Nim.	----	0	---	0	----	0	35	0	--------	--------	------	------
100	Nim.	100	Nim.	20	Cir.	----	0	n e	6	n e	2	35	24	--------	--------	------	------
100	Nim.	100	Nim.	---	--------	n e	2	n e	4	----	0	33	15	*Morn.	**	.01	½
100	Nim.	100	Nim.	100	Nim.	----	0	s e	4	s e	2	32	19	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	e	2	n e	5	s e	7	36	24	‡	††	------	------
100	Nim.	100	Nim.	100	Nim.	s e	2	w	1	w	4	37	32	Rain	Night	.01	------
100	Nim.	100	Nim.	100	Nim.	s w	6	w	6	w	2	32	28	----	--------	------	------
100	Nim.	100	Nim.	100	Nim.	n w	1	s w	5	s w	4	32	29	†Morn.	8 a. m	.06	------
100	Nim.	100	Nim.	100	Nim.	s w	6	s w	7	s w	1	31	25	--------	---	------	------
100	Nim.	100	Nim.	100	Nim.	----	0	e	4	e	1	32	20	*3 p. m.	8 p. m.	.01	1
100	Nim.	100	Nim.	100	Nim.	n e	2	n e	4	n e	3	30	19	*3 p. m	--------	------	------
100	Nim.	100	Nim.	100	Nim.	n e	1	n e	6	---	0	32	20	--------	8 a. m.	.39	5
100	Nim.	100	Nim.	100	Nim.	s e	6	s e	15	s e	15	34	23	--------	--------	------	------
100	Nim.	----	----	100	Nim.	s w	12	s w	18	s w	3	38	24	--------	--------	------	------
100	Nim.	100	Nim.	40	Cir.	n e	1	n e	2	----	0	37	19	*Morn.	4 p. m.	.06	1
100	Nim.	100	Nim.	100	Nim.	s w	4	s w	9	s w	6	39	26	--------	--------	------	------
80	Cir.	100	Nim.	100	Nim.	s w	6	s w	13	s w	10	46	19	--------	--------	------	------
80	Cu.	100	Nim.	----	--------	s w	2	s w	----	s w	----	36	9	--------	--------	-----	------
100	Cir.	20	Cir.	100	Str.	s w		s w	4	s w	4	42	10	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s e	11	s	14	s	12	37	30	§	‡‡	.04	½
100	Nim.	80	Cu.	100	Nim.	n e	2	n e	6	s e	5	37	26	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s e	10	s w	10	w	10	39	23	*Morn.	Morn.	.04	½
100	Nim.	95	Nim.	100	Nim.	s w	9	s w	21	s w	13	31	8	‖	Night	.01	½
----	--------	60	Cir.	----	--------	s w	7	s w	17	s w	14	32	10	*9 p. m.	----	------	------
----	--------	60	Cu.	----	--------	n w	1	n w	4	----	0	27	8	--------	Morn.	------	¼
70	Cir.	100	Nim.	----	--------	s w	2	s w	5	s w	1	17	-4	*11 a. m.	4 p. m.	.03	1
60	Cu.	75	Cu.	----	--------	s w	7	s w	17	s w	8	17	7	*8 a. m.	Flur.	.01	¼
100	Nim.	----	--------	----	--------	n e	----	n e	7	s e	5	------	------	*7 a. m.	Flur.	------	⅛
----	--------	----	--------	----	--------	----	----	----	---	----	----	------	------	--------	--------	.67	10⅝
84	--------	85	------	70	--------	----	----	----	----	----	----	33.55	18.26	--------	--------	------	------
80						----	----	----	----	----	----	------	------	--------	--------	------	------

* Snow.
† Rain.
‡ Snow, 7 a. m.; rain, 3 p. m.
§ Snow, 8 a. m ; rain, 2 p. m.
‖ Snow flurries.
** Night flurries.
†† Flurries continued.
‡‡ 9:30 a. m., night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	20	36	30	28⅔	100	100	100	.108	.212	.167	29.291	29.122	29.173	29.195
2	16	26	26	22⅔	100	100	100	.090	.141	.141	29.321	29.199	28.900	29.140
3	21	30	25	25⅓	100	100	100	.113	.167	.135	29.000	29.071	29.329	29.133
4	24	32	30	28⅔	100	100	100	.129	.181	.167	29.426	29.299	29.030	29.252
5	39	45	30	38	100	100	100	.238	.300	.167	28.331	28.286	28.880	28.499
6	19	23	15	19	100	100	100	.103	.123	.086	29.579	29.579	29.567	29.575
7	17	34	28	26⅓	100	100	100	.094	.196	.153	29.560	29.502	29.411	29.491
8	32	42	32	35⅓	100	100	100	.181	.267	.181	29.299	29.069	29.040	29.136
9	40	52	37	43	100	100	100	.248	.388	.221	28.886	28.740	28.769	28.798
10	31	42	28	33⅔	100	83	76	.174	.222	.117	28.969	29.030	29.080	29.026
11	31	45	36	37⅓	100	100	100	.174	.300	.212	29.184	29.018	28.750	28.984
12	30	30	25	28⅓	78	100	100	.130	.167	.135	28.569	28.762	29.270	28.867
13	18	30	23	23⅔	84	78	100	.082	.130	.123	29.424	29.318	28.891	29.211
14	29	31	16	25⅓	100	100	100	.160	.174	.090	28.639	29.110	29.317	29.022
15	12	35	18	21⅔	100	100	100	.075	.204	.098	29.439	29.398	29.589	29.475
16	5	34	27	22	100	79	100	.055	.155	.147	29.694	29.626	29.559	29.626
17	29	39	34	34	77	100	100	.123	.238	.196	29.379	29.208	28.980	29.189
18	41	47	38	42	100	100	100	.257	.323	.229	28.948	28.967	28.827	28.914
19	39	46	50	45	82	100	100	.195	.311	.361	28.759	28.550	28.351	28.563
20	41	40	39	40	100	100	100	.257	.248	.238	28.458	28.645	28.819	28.641
21	37	54	39	43⅓	81	78	100	.178	.362	.238	28.980	28.999	28.946	28.975
22	42	46	36	41⅓	100	84	100	.267	.262	.212	28.889	28.983	29.115	28.996
23	32	35	33	33⅓	100	100	100	.181	.204	.188	28.946	28.823	28.620	28.796
24	31	36	21	29⅓	100	90	85	.174	.191	.096	28.451	28.567	28.755	28.591
25	23	34	23	26⅔	86	89	100	.106	.175	.123	28.790	28.786	28.914	28.830
26	23	35	15	24	86	89	82	.106	.175	.070	28.916	28.904	29.094	28.971
27	22	40	24	28⅔	86	82	86	.101	.203	.111	29.203	29.236	29.282	29.240
28	34	47	33	38	71	85	80	.138	.273	.150	29.359	29.344	29.316	29.340
29	34	57	42	44⅓	89	87	91	.175	.407	.244	29.319	29.248	29.407	29.325
30	39	67	45	50⅓	82	84	92	.195	.556	.275	29.407	29.379	29.400	29.395
31	41	56	34	43⅔	82	81	89	.212	.363	.175	29.413	29.459	29.437	29.436
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	33.00	93	93	96	.156	.246	.169	--------	--------	--------	29.085
Average	------	------	------	------		94			.190		--------	--------	--------	--------

MARCH, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow. Inches.
100	Nim.	100	Nim.	100	Nim.	n e	8	n e	9	n e	9	38	15	†7:30 am	Flurries	----	----
100	Nim.	100	Nim.	100	Nim.	e	2	----	0	----	0	36	17	**	3 p. m.	.05 .45	1. 1.
100	Nim.	100	Nim.	100	Nim.	----	0	s w	11	s w	7	31	15	----	11 p. m.	----	----
100	Nim.	30	Cir.	100	Nim.	s w	5	s e	9	s	19	39	24	*8 p. m.	9 p. m.	.04	----
100	Nim.	100	Nim.	100	Nim.	s	5	s w	----	s w	----	45	19	----	----	----	----
100	Nim.	----	----	----	----	n e	----	n e	6	n e	3	24	12	----	----	----	----
10	Cir.		----	--	----	n e	1	e	5	s e	5	35	17	----	----	----	----
60	Cir.	100	Nim.	100	Nim.	n w	7	w	8	s	1	43	30	*9:30 am	----	----	----
100	Nim.	100	Nim.	100	Nim.	s w	1	s w	4	s w	6	53	31	Cont.	Night.	.94	----
70	Cu.	----	----	----	----	n w	5	w	12	s w	3	45	25	----	----	----	----
----	----	50	Cu.	100	Nim.	----	0	n e	6	e	10	50	30	§§	----	----	----
100	Nim.	90	Cu.	100	Nim.	s w	----	s w	21	n w	10	32	15	----	----	----	----
----	----	50	Cu.	100	Nim.	n e	1	n e	3	s e	9	30	17	† 11 p m	----	----	----
100	Nim.	100	Nim.	100	Nim.	w	16	w	19	s w	9	33	5	----	† 6 a. m.	----	3½
----	----	100	Nim.	----	----	----	0	s w	10	n e	1	35	2	††	----	----	----
--	----	---	----	80	Cir.	n e	1	n e	5	s e	7	37	5	----	----	---	----
80	Cu.	100	Nim.	100	Nim.	s e	7	s e	11	s w	10	41	28	* 3 p m	----	.01	----
100	Nim.	100	Nim.	100	Nim.	s w	4	s w	7	---	0	49	37	Cont.	----	.01	----
100	Nim.	100	Nim.	100	Nim.	n e	4	e	8	s w	8	50	37	Cont.	----	.42	----
100	Nim.	100	Nim.	100	Nim.	s w	14	s w	14	s w	14	42	35	Cont.	8 p. m.	.12	----
100	Nim.	20	Cu.	----	----	s w	7	n e	1	---	0	56	35	* Night.	Night.	.01	----
100	Nim.	80	Cu.	100	Nim.	----	0	n e	7	n e	3	47	32	----	----	----	----
100	Nim.	100	Nim.	100	Nim.	n e	6	n e	6	n e	4	35	31	†7:30 am	----	----	----
100	Nim.	80	Cu.	100	Cu.	n w	10	n w	12	n w	8	40	21	Cont.	10 a. m.	.47	3
90	Cu.	100	Nim.	----	----	n w	6	w	5	w	4	43	16	----	----	----	----
80	Cu.	60	Cu.	100	Nim.	n e	2	w	----	n w	----	40	10	†4:30 pm	Night.	.11	2½
10	Cu.	----	----	----	----	n w	----	n w	8	n w	4	42	19	----	----	----	----
10	Cir.	----	----	----	----	n e	----	s e	----	s e	6	48	31	----	----	----	----
100	Nim.	----	----	----	----	s e	6	s e	12	s e	4	59	31	*7:30 am	8 a. m.	.01	----
80	Cu.	----	----	----	----	s e	3	n e	7	n e	3	67	34	----	----	----	----
----	----	----	----	----	----	n e	3	e	7	n e	----	57	31	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	2.64	10½
71	----	60	----	64	----	----	----	----	----	----	----	42.23	22.81	----	----	----	----
65						----	----	----	----	----	----	----	----	----	----	----	----

† Snow. * Rain. ** Snow 10:00 a. m.; rain and snow 6:00 p. m.
§§ Rain 7:30 p. m., changing to snow flurries. †† Snow flurries.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	37	55	33	41⅔	81	87	89	.178	.376	.168	29.554	29.499	29.438	29.497
2	38	62	34	44⅔	91	94	100	.208	.523	.196	29.345	29.298	29.327	29.323
3	36	61	38	45	90	83	100	.191	.442	.229	29.379	29.400	29.299	29.359
4	42	59	44	48⅓	100	100	100	.267	.500	.289	28.951	28.790	28.837	28.859
5	49	44	42	45	92	100	100	.322	.289	.267	28.657	28.705	28.750	28.704
6	36	48	39	41	100	100	100	.212	.335	.238	28.850	28.993	29.063	28.969
7	33	34	36	36	100	100	100	.188	.238	.212	29.072	29.084	29.132	29.096
8	34	47	41	40⅔	100	85	100	.196	.273	.257	29.124	29.083	28.999	29.069
9	33	39	25	32⅓	100	100	100	.188	.238	.135	28.930	29.003	29.078	29.003
10	30	40	30	33⅓	89	100	89	.148	.248	.148	29.083	29.114	29.131	29.109
11	35	47	27	36⅓	100	85	88	.204	.273	.129	29.151	29.278	29.334	29.254
12	40	48	42	43⅓	56	78	83	.139	.260	.222	29.449	29.423	29.311	29.394
13	43	57	40	46⅔	100	100	100	.278	.466	.248	28.932	28.932	29.020	28.961
14	40	54	41	45	91	67	100	.225	.282	.257	29.158	29.115	29.108	29.127
15	45	56	47	49⅓	53	63	77	.160	.282	.249	29.065	29.009	28.927	29.000
16	40	41	33	38	100	91	100	.248	.235	.188	28.800	28.830	29.000	28.877
17	31	49	37	39	100	71	71	.174	.247	.157	29.086	29.126	29.152	29.121
18	37	63	55	51⅔	71	57	100	.157	.327	.433	29.110	28.867	28.760	28.912
19	24	30	24	26	100	89	100	.129	.148	.129	29.233	29.438	29.596	29.422
20	23	47	30	33⅓	86	77	70	.106	.249	.131	29.745	29.551	29.482	29.593
21	38	46	46	43⅓	81	84	79	.186	.262	.308	29.468	29.388	29.233	29.363
22	60	61	62	61	82	94	88	.426	.505	.491	29.137	29.134	29.178	29.150
23	58	65	55	59⅓	94	94	100	.452	.583	.433	29.147	29.087	29.104	29.113
24	57	74	64	65	94	81	100	.436	.680	.596	29.135	29.024	28.957	29.039
25	55	61	41	52⅓	94	83	91	.405	.442	.235	28.898	28.915	28.956	28.923
26	41	53	37	43⅔	91	80	81	.235	.321	.178	28.792	28.970	29.180	28.981
27	40	56	46	47⅓	82	81	84	.203	.363	.262	29.240	29.162	29.090	29.164
28	51	67	61	59⅔	79	88	83	.296	.510	.442	29.052	28.990	28.904	28.982
29	55	53	39	49	94	93	100	.405	.375	.238	28.915	28.983	29.030	28.976
30	39	44	37	40	100	100	90	.238	.289	.199	29.001	28.958	28.916	28.958
Sums	------	------	------	------	------	------	------	------	------	------	--------	--------	--------	--------
Means	------	------	------	44.58	90	87	92	.240	.350	.255	--------	--------	--------	29.143
Average	------	------	------	------	90			.282			--------	--------	--------	--------

Thunder storm (slight) 4th—24th.

APRIL, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds. 7 A. M. Per cent of cloud.	Clouds. 7 A. M. Kind.	Clouds. 2 P. M. Per cent of cloud.	Clouds. 2 P. M. Kind.	Clouds. 9 P. M. Per cent of cloud.	Clouds. 9 P. M. Kind.	Winds. 7 A. M. Direction.	Winds. 7 A. M. Force.	Winds. 2 P. M. Direction.	Winds. 2 P. M. Force.	Winds. 9 P. M. Direction.	Winds. 9 P. M. Force.	Registering thermom'r. Maximum.	Registering thermom'r. Minimum.	Rain and snow. Beginning rain or snow.	Rain and snow. Ending rain or snow.	Rain and snow. Inches of rain or melted snow.	Rain and snow. Depth of snow, inches.
40	Cir.	50	Cir.	----	--------	s e	----	s e	13	n e	4	55	30	--------	--------	------	------
60	Cir.	100	Nim.	----	--------	n e	3	n e	5	n e	2	64	27	--------	--------	------	------
----	--------	----	--------	----	--------	n e	1	n e	10	s e	5	63	34	--------	--------	------	------
100	Nim.	100	Nim.	----	--------	s e	6	s	9	s w	7	59	34	* Morn.	5 p. m.	.12	------
80	Nim.	100	Nim.	100	Nim.	s w	11	s w	12	s w	8	47	35	* 8 a. m.	Night	------	------
100	Nim.	100	Nim.	100	Nim.	n e	6	n e	2	n e	2	49	33	Morn	--------	------	------
100	Nim.	100	Nim.		--------	n e	1	n e	2	n e	1	39	25	† Morn.	9 a. m.	.22	1
40	Cir.	90	Nim.	100	Nim.	s w	2	n e	1	n e	1	48	32	--------	--------	--- -	------
100	Nim.	80	Cu.	30	Cir.	n e	5	n e	8	----	0	42	23	--------	--------	------	------
70	Cu.	100	Nim.	100	Nim.	w	3	s w	10	----	0	41	30	--------	--------	------	------
100	Nim.	80	Cu.	----	--------	----	----	n e	2	n e	1	47	22	--------	--------	------	------
10	Cir.	100	Nim.	100	Nim.	s e	1	s e	13	s e	10	50	38	* Night	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s	11	s w	11	s w	15	57	37	--------	Night	.38	------
50	Cir.	75	Cu.	50	Cu.	n w	6	n w	4	n w	5	58	32	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	3	s w	5	s w	3	57	40	*10 p.m.	9 a. m.	------	------
100	Nim.	100	Nim.	100	Nim.	s w	10	s w	10	s	7	44	30	‡	‡	.14	------
100	Nim.	50	Cu.	100	Nim.	n w	6	w	8	s w	4	49	32	--------	--------	--- --	------
50	Cir.	20	Cir.	100	Nim.	s w	12	s w	26	s w	27	64	23	* 8 p. m.	10:30 p.m	.07	------
30	Cu.	90	Nim.	40	Nim.	n w	14	w	7	n w	2	31	14	--------	--------	------	------
----	--------	50	Cu.	----	--------	----	0	s w	4	s	2	48	24	--------	--------	------	------
100	Nim.	100	Nim.	30	Nim.	s e	3	s e	7	s e	5	60	38	*7:30 a.m	3 p. m.	.03	------
-	--------	100	Nim.	--	--------	s	11	s w	----	s w	----	71	55	12 noon	1 p. m	.11	------
100	Nim.	100	Nim.	00	--------	s w	-	w	10	s w	2	70	49	7:45 a.m	3:30 p.m	.28	------
100	Nim.	90	Cum.	100	Nim.	s w	2	s w	6	s w	5	76	52	8 a. m.	--------	--- -	------
100	Nim.	50	Cum.	00	--------	s w	4	s w	5	w	1	64	40	-------	9 a. m.	.15	------
70	Cum.	60	Cum.	00	--------	w	9	w	11	n w	5	56	26	5 a. m.	9 a. m.	.02	------
00	--------	----	--------	----	--------	s e	2	s e	6	s	6	62	37	--------	--------	------	------
----	--------	40	Str.	90	Nim.	s	6	s	5	s	4	77	52	--------	--------	.12	------
100	Nim.	100	Nim.	100	Nim.	s e	1	n e	8	n	9	61	38	1:30	2	.03	------
100	Nim.	100	Nim.	100	Nim.	n	6	n	6	n	2	48	35	§	‖	.02.45	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	2.74	1
67	--------	78	--------	51	--------	----	----	----	----	----	----	55.23	33.90	--------	--------	------	------
		65				----	----	----	----	----	----	------	------	-------	--------	------	------

* Rain. † Snow. ‡ Rain and snow, 6 p. m., night. § 6:30 a. m., 3 p. m. ‖ 7 a. m , 12 m.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in open air.				Relative humidity or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	36	39	36	37	90	81	100	.191	.186	.212	28.861	28.858	28.811	28.843
2	39	48	43	43⅓	100	100	100	.238	.335	.278	28.670	28.686	28.775	28.710
3	42	48	48	46	100	100	100	.267	.335	.335	28.851	28.929	29.015	28.932
4	48	64	48	53⅓	100	83	100	.335	.497	.335	29.075	29.100	29.159	29.111
5	54	75	53	60⅔	80	68	100	.335	.591	.403	29.230	29.209	29.186	29.208
6	54	67	53	58	100	84	100	.418	.556	.403	29.172	29.156	29.217	29.182
7	59	68	53	60	82	75	100	.410	.509	.403	29.254	29.265	29.289	29.269
8	67	72	55	64⅔	79	76	81	.522	.595	.349	29.349	29.243	29.185	29.259
9	68	78	55	67	85	86	100	.577	.827	.433	29.162	28.881	28.984	29.009
10	68	72	51	63⅔	100	81	100	.685	.631	.374	28.995	28.954	28.964	28.971
11	62	75	63	66⅔	72	68	72	.399	.591	.416	28.916	28.851	28.844	28.870
12	58	63	53	58	82	42	67	.394	.243	.269	28.751	28.816	28.776	28.781
13	54	63	49	55⅓	80	42	85	.335	.243	.297	28.791	28.816	28.792	28.880
14	48	55	48	50⅓	93	62	63	.310	.269	.212	28.753	28.852	29.032	28.879
15	44	61	44	49⅔	68	83	100	.196	.442	.289	29.170	29.210	29.230	29.203
16	57	67	44	56	81	79	100	.378	.522	.289	29.320	29.288	29.309	29.306
17	55	69	48	57⅓	87	75	100	.376	.529	.335	29.354	29.346	29.329	29.343
18	65	75	60	66⅔	78	73	94	.483	.628	.487	29.329	29.316	29.314	29.320
19	65	78	67	70	68	95	100	.420	.914	.662	29.304	29.252	29.061	29.206
20	60	69	55	61⅓	100	100	94	.518	.708	.405	28.919	28.849	28.925	28.898
21	45	60	41	48⅔	92	88	100	.275	.456	.257	29.077	29.069	29.087	29.078
22	57	68	60	61⅔	87	95	100	.407	.648	.518	29.058	28.885	28.797	28.913
23	55	69	50	58	100	85	100	.433	.599	.361	28.719	28.714	28.871	28.768
24	45	50	41	45⅓	100	93	91	.300	.335	.235	28.987	29.085	29.195	29.089
25	45	62	44	50⅓	92	72	100	.275	.399	.289	29.319	29.343	29.349	29.337
26	47	62	45	51⅓	70	72	92	.225	.399	.275	29.417	29.349	29.312	29.359
27	55	67	55	59	87	90	100	.376	.635	.433	29.291	29.192	29.170	29.218
28	55	60	47	54	100	94	85	.433	.487	.273	29.063	29.021	29.055	29.046
29	57	69	57	61	87	90	100	.407	.635	.466	29.018	28.888	28.821	28.909
30	54	56	36	48⅔	100	87	100	.418	.391	.212	28.771	28.851	28.962	28.861
31	44	56	42	47⅔	92	81	100	.265	.363	.267	29.023	29.027	29.099	29.050
Sums														
Means				55.83	88	81	94	.374	.500	.347				29.058
Averages					88			.407						

MAY, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud	Kind.	Direction.	Force.	Direction.	Force.	Direction	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Nim.	100	Nim	100	Nim.	n w	..	n w	----	n w	3	39	34	*Contin	ued.	---	------
100	Nim.	100	Nim.	100	Nim.	n e	4	n e	5	n e	6	48	39	*Contin	ued.	.85	------
100	Nim.	100	Nim.	100	Nim.	n e	1	n e	----	n e	----	48	41	*Cont.	--	.45	------
100	Nim.	60	Cu.	----	--------	n	--		0	s w	3	70	41	Cont.	Morning	.15	------
----	--------	----	--------	----	--------	s w	2	s w	2	s e	2	79	46	--------	--------	------	------
100	Nim.	100	Nim.	----	--------	s w	2	n e	1	s w	3	72	38	*2 p. m.	2:30 pm	‖	------
----	--------	----	--------	--	--------	n e	2	n e	--	n e	5	70	42	--------	--------	------	------
---	--------	--	--------	50	Nim.	s e	----	s e	11	s e	8	73	52	--------	-----	------	------
10	Cir.	100	Nim.	100	Cir.	s w	6	s w	11	s w	1	81	45	†	4 p. m.	.11	------
----	--------	----	--------	----	--------	s w	3	s w	7	s w	1	76	43	--------	--------	.11	------
20	Cu.	35	Cu.	100	Cu.Str.	s w	7	s w	11	s w	4	75	54	--------	--------	------	------
80	Cir. Cu.	40	Cu.	5	Cir.Str.	s w	4	n w	14	n w	5	64	49	* Nig	ht.	.11	------
20	Cir. Cu.	80	Cu. Str.	100	Nim.	s w	2	s w	11	w	2	46	17	4:30pm	Night.	.28	------
100	Cu.	90	Cu.	5	Cir. Cu	n w	4	n w	10	s w	3	78	33	‡	5 p. m.	.07	------
75	Cir.Str.	90	Cu.	30	Str.	s w	1	s w	3	----	0	67	36	--------	--------	.62	------
----	--------	90	Cu.	----	--------	s w	2	s w	5	s w	2	78	38	--------	--------	------	------
30	Cir.	80	Cu.	----	--------	s w	2	s w	7	s w	5	72	47	--------	--------	------	------
100	St.	--	--------	----	--------	w	4	s w	6	s w	5	81	48	--------	--------	------	------
----	--------	60	Cir.	--	--------	s w	4	s w	10	s w	7	80	60	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s w	7	s w	10	n w	7	73	43	Rain Mo.	6 p. m.	.45	------
100	Nim.	10	Cu.	----	--------	n e	5	s e	4	n e	1	64	35	--------	--------	------	------
----	--------	100	Nim.	100	Nim.	s	5	s w	12	s w	11	69	51	*4 p.m.	--------	.45	------
100	Nim.	60	Cu.	100	Nim.	s w	3	s w	17	s w	3	70	43	--------	Morning	------	------
100	Nim.	100	Nim.	100	Nim.	n w	4	n w	6	n w	2	52	30	--------	--------	------	------
20	Cir.	70	Cu.	----	--------	s e	3	s e	3	----	0	64	32	--------	--------	------	------
----	--------	----	--------	----	--------	s e	4	s e	3	--	0	69	33	--------	--------	------	------
10	Cir.	----	--------	30	Nim.	----	0	----	0	s w	1	76	52	--------	--------	------	------
100	Nim.	90	Nim.	100	Nim.	n w	5	n w	10	n w	6	60	43	Rain Mo.	8 a. m.	------	------
90	Nim.	80	Nim.	50	Nim.	n w	5	s w	4	s w	1	72	48	--	--------	------	------
100	Nim.	95	Nim.	----	--------	s w	7	n w	14	w	7	57	33	Rain Mo.	8 a. m.	.10	------
----	--------	50	Cu.	----	--------	w	8	s w	9	s w	2	57	36	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	3.75	------
53	--------	63	--------	41	--------	----	----	----	----	----	----	67.10	41.35	--------	--------	-----	------
52						----	----	----	----	----	----	------	------	-----	--------	------	------

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* Rain. † Rain in night, 1 p. m. ‡ 11:40 a. m, Hail, 1 p. m. ‖ Trace.
Thunder storms (2) May 9. Thunder storms May 20.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	47	58	47	50⅔	92	94	85	.298	.452	.273	29.225	29.237	29.237	29.233
2	60	73	64	65⅔	82	77	100	.426	.617	.596	29.156	28.981	28.871	29.003
3	68	61	54	61	100	100	87	.685	.537	.362	28.794	28.842	28.939	28.858
4	52	68	46	55⅓	86	75	100	.334	.509	.311	28.947	28.961	28.996	28.968
5	57	71	50	59⅓	88	80	100	.439	.608	.361	28.979	28.961	28.971	28.970
6	60	66	54	60	100	89	100	.518	.570	.418	28.979	28.999	29.019	28.999
7	49	62	45	52	92	77	100	.322	.429	.300	29.060	29.086	29.162	29.103
8	54	65	44	54⅓	87	78	100	.362	.483	.289	29.214	29.208	29.229	29.217
9	58	71	48	59	82	76	100	.394	.572	.335	29.254	29.229	29.202	29.228
10	58	76	62	65⅓	88	68	83	.423	.614	.460	29.222	29.214	29.123	29.186
11	63	76	60	66⅓	88	95	100	.510	.654	.518	29.045	28.983	29.039	29.022
12	63	80	66	69⅔	83	66	89	.478	.677	.570	29.050	28.958	28.931	28.980
13	74	84	62	73⅓	86	64	94	.718	.746	.523	29.836	28.935	28.958	28.910
14	68	87	62	72⅓	90	72	100	.612	.928	.556	29.074	29.043	29.020	29.046
15	75	90	67	77⅓	100	70	100	.868	.983	.662	29.071	28.993	29.006	29.023
16	66	74	60	66⅔	100	95	100	.639	.798	.518	29.026	28.974	28.969	28.990
17	62	80	60	67⅓	100	83	94	.556	.843	.487	28.899	28.978	29.014	28.964
18	63	74	61	66	94	95	100	.543	.798	.537	29.039	29.050	29.070	29.053
19	60	79	57	65⅓	100	87	94	.518	.856	.436	29.021	28.939	29.002	28.987
20	57	67	48	57⅓	94	64	92	.436	.425	.310	29.118	29.009	29.155	29.124
21	54	67	57	59⅓	93	69	94	.390	.457	.436	29.185	29.100	29.044	29.110
22	62	67	65	64⅔	77	69	100	.429	.457	.618	28.996	28.907	28.877	28.927
23	70	86	68	74⅔	90	90	95	.658	1.138	.648	28.891	28.927	28.941	28.920
24	70	85	68	74⅓	90	79	95	.658	.955	.648	28.941	28.959	29.011	28.970
25	63	78	63	68	77	78	67	.446	.744	.386	29.085	29.107	29.185	29.126
26	57	72	54	61	87	76	100	.407	.595	.418	29.253	29.226	29.225	29.235
27	65	76	56	65⅔	84	73	100	.516	.652	.449	29.269	29.200	29.196	29.222
28	69	72	67	69⅓	75	76	95	.529	.595	.626	29.203	29.162	29.129	29.165
29	67	87	70	74⅔	95	72	90	.626	.928	.658	29.003	28.933	28.914	28.950
30	76	87	68	77	91	65	100	.812	.836	.685	29.025	28.994	29.014	29.011
Sums														
Means				64.21	90	78	95	.518	.689	.480				29.050
Average					88			.562						

JUNE, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud	Kind.	Per cent of cloud.	Kind.	Direction.	Force	Direction	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow inches.
----	--------	50	Cir.	----	--------	s w	3	s w	2	s w	1	66	45	--------	--------	------	------
-	--------	30	Cir.	100	Nim.	s w	11	s w	12	s w	5	77	52	* 5 p.m.	----	------	------
100	Nim.	100	Nim.	100	Nim.	s w	4	s w	13	s w	11	70	49	Cont.	12 a. m.	.43	------
100	Nim.	50	Cu.	20	Str.	n w	10	n w	8	s w	1	69	45	--------	--------	------	------
75	Cir.	70	Cu.	----	--------	s w	4	s w	12	s w	2	71	49	--------	--------	-----	------
100	Nim.	70	Nim.	100	Nim.	s w	3	w	8	n w	3	71	45	*9:30am	----	------	------
100	Nim.	80	Cu.	----	--------	n e	1	n e	4	n e	2	69	42	--------	Morn.	.19	------
----	--------	50	Cu.	---	--------	s e	3	s e	3	----	0	71	34	--------	--------	- -	------
----	--------	50	Cu.	20	Cir.	---	0	s e	3	----	0	76	42	* Morn.	--------	Tr.	------
100	Nim.	50	Cu.	60	Nim.	s e	2	s e	5	s e	3	79	51	--------	--------	------	------
100	Nim.	80	Nim.	50	Str.	s w	4	w	7	s w	2	80	52	* Morn.	Morn.	.50	------
----	--------	50	Cu.	60	Nim.	s w	----	s w	8	s w	2	83	55	--------	--------	---	------
----	--------	50	Cu.	--	--- ---	s w	3	s w	10	s w	1	88	59	*Night.	Night.	.55	------
----	--------	20	Cir.	50	Cir.	--	0	s w	4	----	0	90	62	--------	--------	------	------
100	Nim.	75	Cu.	50	Str.	s w	1	s w	8	s e	1	91	62	--------	--------	------	------
100	Nim.	100	Nim.	100	Nim.	s e	3	s e	10	s e	1	79	58	*6:40am	11 a. m.	.54	------
100	Nim.	90	Cu.	100	Nim.	s e	5	n e	3	n e	---	82	55	*Night.	Night.	.01	------
100	Nim.	80	Cu.	50	Cu.	n e	--	s e	7	s e	2	79	54	--------	--------	---	------
100	Nim.	30	Cu.	60	Str.	s w	2	s w	6	s w	5	82	49	* 9 a.m.	9:10 a m	.01	------
20	Cir.	60	Cu.	----	--------	n e	3	n e	6	n e	3	70	35	--------	--------	------	------
----	--------	----	--------	----	--------	s e	3	s e	3	s w	1	70	43	--------	--------	------	------
10	Cir.	----	--------	----	--------	s w	6	s w	9	s w	5	81	58	--------	--------	------	------
100	Nim.	60	Cu.	100	Nim.	s w	10	s w	8	s w	4	88	60	*Night.	Night.	Tr.	------
20	Cir.	60	Cu.	90	Cu.	w	6	w	7	w	2	85	52	*Night.	Night.	.04	------
50	Cir.	50	Cu.	100	Nim.	n e	2	n e	6	n e	4	79	44	--------	--------	------	------
60	Cir.	60	Cu.	50	Cu. Str.	n e	2	n e	2	s e	1	75	45	--------	--------	------	------
----	--------	50	Cu.	---	--------	s w	1	s w	3	s w	----	81	48	--------	--------	------	------
20	Str.	50	Cu.	60	Cu.	s w	--	s w	8	s e	6	81	63	*12:30	1 p. m,	.01	------
100	Nim.	40	Nim.	50	Nim.	w	7	w	13	w	3	90	62	* Morn.	6 p. m.	.29	------
50	Cu.	50	Cu.	50	Cu.	s w	2	s w	7	w	3	90	62	--------	--------	----	------
----	--------	----	--------	---	--------	----	----	----	----	----	----	------	------	--------	--------	2.57	------
54	--------	55	--------	47	--------	----	----	----	--	--	----	78.77	51.07	--------	--------	------	------
52						----	----	----	--	----	----	------	------	--------	--------	------	------

* Rain.
Violent thunder storm 13th.
Thunder storm 16th.
Thunder storm 29th.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	69	87	67	74⅓	100	69	100	.708	.882	.662	28.967	28.879	28.858	28.901
2	77	92	78	82⅓	65	74	100	.601	1.108	.958	28.880	28.876	28.961	28.906
3	80	95	78	84⅓	91	65	95	.931	1.066	.854	29.014	29.931	28.972	28.972
4	85	97	73	85	79	56	100	.955	.998	.812	29.010	28.985	29.009	29.001
5	82	92	62	78⅔	91	74	100	.996	1.108	.556	29.023	29.059	29.150	29.080
6	81	90	68	79⅔	70	70	85	.745	.983	.577	29.118	29.177	29.208	29.168
7	76	91	69	78⅔	86	67	90	.772	.970	.635	29.198	29.172	29.163	29.178
8	76	95	76	82⅓	86	71	95	.772	1.173	.854	29.162	29.080	29.075	29.106
9	80	99	77	85⅓	87	66	95	.886	1.229	.884	29.024	28.985	28.978	28.996
10	79	85	74	79⅓	91	79	90	.900	.953	.758	28.958	28.896	28.878	28.911
11	62	79	68	69⅔	100	91	79	.556	.900	.543	28.880	28.916	28.895	28.897
12	62	70	58	63⅓	83	75	100	.460	.551	.483	28.889	28.863	28.864	28.872
13	60	71	59	63⅓	94	71	100	.487	.537	.500	28.858	28.851	28.894	28.868
14	64	78	58	66⅔	94	62	100	.563	.588	.500	28.908	28.930	29.016	28.951
15	64	77	68	69⅔	89	77	100	.529	.717	.685	29.087	29.097	29.109	29.098
16	71	65	63	66⅓	95	100	100	.720	.618	.576	29.135	29.145	29.174	29.151
17	67	79	68	71⅓	89	82	90	.591	.813	.612	29.195	29.164	29.208	29.189
18	68	83	68	73	90	75	100	.612	.846	.685	29.224	29.188	29.227	29.213
19	67	84	67	72⅔	100	79	100	.662	.923	.662	29.254	29.173	29.171	29.199
20	68	80	67	71⅔	100	78	79	.685	.800	.522	29.110	29.015	28.984	29.036
21	69	83	68	73⅓	100	75	100	.708	.846	.685	28.900	28.938	28.925	28.921
22	73	80	68	73⅔	85	87	95	.693	.886	.648	28.875	28.871	28.894	28.880
23	66	77	61	68	94	82	100	.604	.758	.527	28.898	28.918	28.985	28.934
24	68	81	68	72⅓	95	79	100	.648	.829	.685	28.988	28.964	29.008	28.987
25	69	83	71	74⅓	95	87	95	.671	.983	.720	29.013	28.971	28.981	28.988
26	70	76	70	72	100	95	95	.733	.854	.695	28.892	28.822	28.802	28.839
27	68	71	67	68⅔	100	95	100	.685	.720	.662	28.893	28.916	28.991	28.933
28	66	79	63	69⅓	94	78	94	.604	.772	.543	29.009	28.997	29.021	29.009
29	69	83	65	72⅓	95	72	100	.671	.802	.618	29.076	29.109	29.107	29.097
30	67	85	67	73	95	87	95	.626	1.051	.626	29.111	29.078	29.118	29.102
31	68	83	67	72⅔	95	87	100	.648	.983	.662	29.170	29.103	29.142	29.138
Sums														
Means				73.79	91.23	77.58	95.87	.691	.879	.658				29.017
Average					88.23			.743						

JULY, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering Thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
90	Cu.	50	Cu. Cir.	50	Cu.	w	1	w	3	w	1	91	56	--------	--------	------	------
30	Cir.	50	Cu.	----	--------	s w	2	s w	5	s w	1	96	55	--------	--------	------	------
20	Cir.	40	Cu.	----	--------	s w	5	s w	9	s w	----	97	70	--------	--------	------	------
----	--------	----	--------	----	--------	s w	----	s w	13	s w	2	98	69	--------	--------	------	------
20	Cir.	40	Cu.	----	--------	s w	3	s w	7	s w	3	93	61	--------	--------	------	------
----	--------	----	--------	----	--------	s w	3	s w	4	n e	1	93	52	--------	--------	------	------
----	--------	20	Cir.	----	--------	n e	2	s e	7	s e	3	94	57	--------	--------	------	------
----	--------	20	Cu.	----	--------	----	0	s w	2	s w	2	100	64	--------	--------	------	------
----	--------	20	Cu.	50	Nim.	s w	3	s w	2	s w	2	100	67	--------	--------	------	------
20	Cir.	90	Nim.	40	Nim.	s w	1	s w	5	s w	5	100	62	--------	--------	------	------
100	Nim.	30	Cir.	20	Cu.	n	7	n w	3	s e	2	80	55	6:30 a. m.	11:30a.m.	1.12	------
40	Cir.	30	Cu.	50	Nim.	s e	2	n w	5	n w	2	73	53	5:30 p. m.	8:30 p. m.	.53	------
80	Cu. Nim.	80	Cu.	30	Nim.	n w	3	n w	4	n w	----	74	51	5 p. m.	6:30 p. m.	.16	------
----	--------	10	Cu.	----	--------	n w	----	n w	7	n w	2	80	52	4 p. m.	5 p. m.	Trace	------
80	Nim.	30	Cu.	30	Cu.	s w	2	s w	6	s w	2	84	57	--------	--------	-----	------
10	Cir.Str.	100	Nim.	30	Cir.	s w	1	s w	2	----	0	85	57	1 p. m.	2:30 p. m.	.80	------
----	--------	80	Cu. Nim.	----	--------	s w	3	n w	2	n e	2	84	56	--------	--------	Trace	------
----	--------	10	Cu.	----	--------	n e	2	n e	3	----	0	88	57	--------	--------	.02	------
60	Cir.	40	Cu.	----	--------	e	2	e	2	----	0	87	61	--------	--------	------	------
Fog	Fog.	40	Cu.	20	Cir.	s e	1	s w	7	s w	4	88	65	--------	--------	------	------
100	Nim.	----	--------	----	--------	s w	----	w	7	w	5	86	65	6 a. m.	7 a. m.	1.22	------
----	--------	60	Cu.	60	Cu.	s w	9	w	12	w	4	80	58	--------	--------	------	------
90	Cir.	30	Cir.	----	--------	n w	7	n w	8	n w	4	81	54	--------	--------	------	------
20	Cir.	10	Cir.	----	--------	s w	2	s w	4	----	0	84	57	--------	--------	------	------
----	--------	40	Cir.	40	Cir.	s e	1	s e	----	s	----	88	65	--------	--------	------	------
100	Nim.	100	Cu. Nim.	100	Cu. Nim.	s e	----	s w	2	s w	5	76	61	*	†	§	------
50	Cir.	100	Cu. Nim.	50	Cir.	s e	5	s w	4	----	0	76	56	‡	‡	.30	------
100	Cir.	40	Cu.	---	--------	n	5	n w	3	n w	1	82	54	--------	--------	------	------
----	--------	10	Cu.	----	--------	w	3	s w	4	s w	1	92	57	--------	--------	------	------
100	Cir.	20	Cir.	----	--------	n w	4	s w	11	s w	1	88	55	--------	--------	------	------
50	Cir.	40	Cir.	10	Cir.	s w	1	s w	3	s w	1	88	60	--------	--------	------	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	8.49	------
37	--------	40	--------	19	--------	----	----	----	---	----	----	87.29	58 68	--------	--------	------	------
32						----	----	----	----	----	----	------	------	--------	--------	------	------

* 6:30 a. m., 1:30 p. m. † 10;30 a. m., 6 p. m. ‡ Showers during day.
§ 6:30 a. m. to 10:30 a. m., 2.50; 1:30 p. m. to 5 p. m., 1.84; 4.34 in 12 hours.
Thunder showers, July 12, 13, 16, 17 (slight), 18.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	65	82	70	72⅓	100	87	95	.618	.950	.695	29.149	29.061	29.091	29.100
2	70	85	72	75⅔	85	79	90	.621	.955	.706	29.081	29.058	29.076	29.072
3	71	87	71	76⅓	95	72	90	.720	.928	.682	29.107	29.113	29.167	29.129
4	68	66	61	65	85	100	94	.577	.639	.505	29.206	29.215	29.255	29.225
5	65	78	61	68	89	86	100	.549	.827	.537	29.340	29.358	29.351	29.350
6	64	79	61	68	89	69	100	.529	.691	.537	29.363	29.305	29.245	29.304
7	63	79	65	69	88	66	100	.510	.651	.618	29.256	29.175	29.126	29.186
8	73	83	64	73⅓	85	67	100	.693	.759	.596	29.088	29.018	29.037	29.048
9	68	71	69	69⅓	95	86	90	.648	.644	.635	29.011	28.980	28.937	28.976
10	65	74	65	68	89	77	94	.549	.641	.583	28.889	28.837	28.901	28.876
11	61	73	61	65	94	85	88	.505	.693	.473	28.905	28.923	28.971	28.933
12	62	72	55	63	77	66	100	.429	.524	.433	29.068	29.081	29.150	29.100
13	62	82	62	68⅔	94	67	100	.523	.731	.556	29.172	29.095	29.068	29.112
14	66	72	68	68⅔	89	90	100	.570	.706	.685	28.987	28.920	28.880	28.929
15	71	79	62	70⅔	90	78	94	.682	.772	.523	28.828	28.729	28.753	28.770
16	59	64	53	58⅔	100	83	100	.500	.497	.403	28.899	28.937	29.025	28.954
17	52	65	51	56	93	92	100	.361	.583	.374	29.067	29.039	29.055	29.054
18	61	73	60	64⅔	88	67	100	.473	.545	.518	29.026	28.967	28.997	28.997
19	53	68	53	58	100	95	100	.403	.648	.403	29.069	29.077	29.121	29.089
20	51	69	51	57	86	61	100	.321	.430	.374	29.219	29.200	29.190	29.203
21	54	76	56	62	87	77	100	.362	.691	.449	29.186	29.107	29.091	29.128
22	56	78	57	63⅔	87	73	94	.391	.704	.433	29.079	29.048	29.100	29.076
23	54	68	61	61	93	90	100	.390	.612	.537	29.096	29.069	29.051	29.072
24	63	74	57	64⅔	88	81	100	.510	.680	.460	28.905	28.838	28.858	29.867
25	54	72	51	59	100	66	100	.418	.524	.374	29.009	29.026	29.079	29.039
26	68	79	69	68⅔	88	66	79	.423	.651	.564	29.111	29.018	28.916	29.015
27	65	79	51	65	84	62	100	.516	.612	.374	28.964	28.980	29.066	29.003
28	60	84	66	70	88	68	84	.456	.789	.536	29.153	29.092	29.077	29.107
29	70	84	53	69	90	68	86	.658	.789	.348	29.006	28.918	29.107	29.010
30	63	73	52	62⅔	88	72	100	.510	.581	.388	29.222	29.182	29.164	29.189
31	53	76	60	63	100	64	100	.403	.577	.518	29.154	29.145	29.139	29.146
Sums	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Means	-----	-----	-----	65.94	90.45	76.13	96.06	.510	.678	.510	-----	-----	-----	29.066
Averages	-----	-----	-----	-----	87.55			.566			-----	-----	-----	-----

AUGUST, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud	Kind.	Per cent of cloud	Kind.	Per cent of cloud	Kind.	Direction	Force.	Direction.	Force.	Direction	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Nim.	40	Cir. Cu.	----	--------	s w	2	s w	6	s e	5	87	63	6:30 a m	7:30 a m	†	------
----	--------	20	Cir.	20	Cir.	e	4	e	3	e	3	88	63	In night.		.03	------
75	Nim.	10	Cu.	----	--------	s e	2	s e	2	e	2	90	62	8:30 a m	5 p. m.	‡	------
100	Cir. Cu.	100	Nim.	10	Cir.	e	3	n e	2	n e	1	87	53	--------	--------	------	------
----	--------	10	Cu.	10	Cir.	n e	3	e	3	----	0	82	48	--------	--------	------	------
----	--------	60	Cir.	--	--------	e	1	e	3	----	0	82	48	--------	--------	------	------
40	Cir.	60	Cir. Cu.	60	Cir.	s e	1	s e	3	s e	1	82	58	--------	--------	------	------
80	Cir. Cu.	20	Cu.	--	--------	s	1	s	1	s w	2	84	54	7:30 a m	8 a. m.	†	------
80	Cir. Cu.	80	Cu. Nim.	60	Cir. Cu.	s w	2	s w	7	s w	3	78	56	10:30am	11:30am	.23	------
----	--------	60	Cir. Cu.	60	Cu. Nim.	s w	3	n w	7	s w	1	78	53	9 p. m.	9:30 p m	†	------
30	Cir.	80	Cu. Nim.	----	--------	n	1	w	----	n w	----	78	46	--------	--------	------	------
----	--------	----	--------	----	--------	n w	----	n w	4	----	0	76	40	--------	--------	------	------
----	--------	10	Cir.	----	--------	w	4	w	7	w	1	84	52	--------	--------	------	------
60	Cir.	100	Cu. Nim.	----	--------	s w	4	s w	11	s w	8	77	58	11:30am	12:30pm	.08	------
----	--------	40	Cu.	----	--------	s w	8	s w	11	w	5	80	54	In night.		.31	------
100	Nim.	100	Cir. Cu.	----	--------	n w	6	n w	5	n w	2	68	40	8 a. m.	8:30 a m	†	------
80	Cir. Str.	40	Cir. Cu.	----	--------	n w	2	n w	6	n w	1	70	44	--------	--------	------	------
40	Cir. Str.	20	Cir.	40	Cir.	s w	5	s w	10	w	1	76	53	In night.		.07	------
100	Nim.	30	Cir.	40	Cir.	n w	3	n w	5	n w	2	70	40	--------	--------	------	------
----	--------	----	--------	----	--------	n w	1	w	5	----	0	73	42	--------	--------	------	------
----	--------	----	--------	----	--------	w	3	w	6	----	0	80	44	--------	--------	------	------
----	--------	50	Cir. Cu	100	Cir.	s w	1	n e	2	n e	3	82	52	--------	--------	------	------
100	Nim.	60	Cir.	----	--------	s e	1	s e	3	s e	3	76	53	10 a m	11:30am	.06	------
50	Cir.	60	Cu.	----	--------	s e	4	s w	11	s w	1	77	52	*	*	.04	------
----	--------	----	--------	----	--------	s w	2	----	0	----	0	74	44	--------	--------	------	------
----	--------	----	--------	----	--------	s e	5	s w	10	s w	9	81	52	--------	--------	------	------
----	--------	----	--------	----	--------	s w	5	s w	10	----	0	82	47	--------	--------	------	------
----	--------	----	--------	----	--------	-	0	s	2	s	3	86	59	--------	--------	------	------
20	Cir.	50	Cu.	20	Cir.	s w	10	w	12	----	0	86	45	In night.		.11	------
----	--------	----	--------	----	--------	n w	2	s w	6	----	0	86	49	--------	--------	------	------
40	Cir.	40	Cir.	80	Cir.	w	2	s e	3	s e	1	78	53	In night.		†	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	--------	--------	1.69	------
35	--------	37	--------	14	--------	----	----	----	----	----	----	79.93	50.87	--------	--------	----	------
29						----	----	----	----	----	----	------	------	--------	--------	------	------

* Shower, afternoon. † Trace. ‡ .75, .01 to noon.
August 4, thunder shower; August 9, thunder shower.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7. A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	60	63	60	61	100	100	100	.518	.576	.518	29.114	29.048	29.150	29.104
2	61	72	62	65	100	90	100	.537	.706	.556	29.272	29.300	29.303	29.292
3	54	76	54	61⅓	93	64	100	.390	.577	.418	29.316	29.374	29.394	29.361
4	55	80	63	66	100	62	88	.433	.638	.510	29.424	29.352	29.329	29.368
5	73	88	64	75	90	84	100	.732	1.111	.596	29.359	29.328	29.305	29.331
6	63	85	64	70⅔	100	79	100	.576	.955	.596	29.354	29.321	29.311	29.329
7	65	87	58	70	89	62	94	.549	.792	.452	29.364	29.344	29.255	29.321
8	64	90	68	74	83	63	95	.497	.887	.648	29.289	29.233	29.176	29.233
9	67	93	67	75⅔	89	58	89	.591	.894	.591	29.245	29.233	29.241	29.240
10	65	92	67	74⅔	100	85	89	.618	1.269	.591	29.275	29.272	29.260	29.269
11	62	67	68	65⅔	94	89	95	.523	.521	.648	29.306	29.304	29.296	29.302
12	66	85	67	72⅔	94	75	95	.604	.909	.626	29.252	29.216	29.122	29.197
13	66	79	66	70⅓	94	91	100	.604	.900	.639	29.195	29.177	29.185	29.186
14	61	87	68	72	100	76	95	.537	.976	.648	29.269	29.267	29.267	29.268
15	65	69	76	76⅔	78	100	86	.483	1.057	.772	29.264	29.190	29.116	29.190
16	72	72	69	71	95	95	90	.745	.745	.685	29.128	29.088	29.259	29.158
17	59	63	43	55	88	88	83	.439	.510	.231	29.404	29.374	29.263	29.347
18	46	71	57	58	84	76	100	.262	.572	.466	29.127	28.985	28.923	29.012
19	52	58	43	51	86	76	100	.334	.365	.278	29.079	29.113	29.237	29.143
20	39	58	35	44	91	76	100	.225	.365	.204	29.425	29.417	29.421	29.421
21	35	57	50	47⅓	100	81	85	.204	.378	.309	29.437	29.391	29.242	29.357
22	48	74	50	57⅓	85	81	100	.285	.680	.361	29.216	29.195	29.228	29.213
23	47	74	49	56⅔	100	67	100	.323	.568	.348	29.226	29.183	29.184	29.198
24	43	75	46	54⅔	83	73	100	.231	.628	.311	29.211	29.196	29.199	29.202
25	56	81	53	63⅓	94	91	93	.420	.963	.375	29.213	29.162	29.097	29.157
26	60	74	47	60⅓	88	77	100	.456	.641	.323	29.075	29.099	29.293	29.156
27	43	63	43	49⅔	83	72	83	.231	.416	.231	29.434	29.457	29.463	29.451
28	35	70	47	50⅔	90	66	92	.183	.482	.298	29.523	29.417	29.383	29.441
29	43	70	47	53⅓	92	53	100	.254	.385	.323	29.399	29.382	29.368	29.383
30	54	86	54	64⅔	74	58	100	.308	.719	.418	29.417	29.378	29.368	29.388
Sums														
Means				62.92	88.29	76.93	95.07	.436	.706	.464				29.267
Average					86.76			.535						

SEPTEMBER, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Cu.Nim.	100	Nim.	30	Cir.	s e	2	s e	2	s	1	66	47	9:00 am	1:30 pm	.45	----
100	Cir.	80	Cir.	----	----	----	0	n e	2	----	0	72	49	----	----	----	----
----	----	----	----	----	----	n e	2	n e	3	n e	1	76	46	----	----	----	----
----	----	----	----	----	----	w	2	w	7	s w	6	82	49	----	----	----	----
----	----	20	Cir.	----	----	s w	4	s w	7	s w	1	90	57	----	----	----	----
30	Cir.	60	Cir.	----	----	s w	2	s w	3	----	0	88	52	----	----	----	----
60	Cir.	40	Cir.	----	----	s w	2	s w	5	s	1	88	52	----	----	----	----
----	----	----	----	----	----	----	0	s w	4	s w	2	94	62	----	----	----	----
----	----	----	----	----	----	s w	3	s w	7	----	0	94	56	----	----	----	----
----	----	20	Cu.	20	Cir.	s w	3	s w	----	s w	----	92	61	----	----	----	----
100	Nim.	100	Cir.	40	Cir.	s w	----	s w	2	w	1	70	56	1:00	7:30 am	.08	----
100	Cu.	----	----	40	Cir.	s w	5	s w	4	s w	1	88	62	----	----	----	----
100	Nim.	80	Cir. Cu.	----	----	s w	1	s w	1	----	0	82	60	8:30 am	9:30 am	.21	----
20	Cir.	----	----	----	----	s	4	s	4	w	6	84	60	----	----	----	----
----	----	60	Cu.	----	----	s	6	s	6	s e	3	92	68	----	----	----	----
----	----	60	Cu.Nim.	----	----	s e	2	s	6	n	7	82	47	11:30am	12:00 m	.06	----
----	----	----	----	----	----	----	0	n w	3	w	1	68	38	----	----	----	----
----	----	----	----	----	----	s e	5	s w	13	w	2	74	47	----	----	----	----
20	Cir. Str.	40	Cu.	----	----	n w	3	n w	5	n w	2	60	35	----	----	----	----
15	Cir.	----	----	----	----	----	0	----	0	n w	1	60	28	----	----	----	----
----	----	60	Cir.	100	Nim.	s e	4	s w	10	s w	2	69	41	----	----	----	----
20	Cir. Str.	----	----	----	----	s w	3	s w	4	----	0	75	43	----	----	----	----
Fog	----	----	----	----	----	s e	1	n e	3	----	0	76	37	----	----	----	----
----	----	----	----	----	----	s e	1	s e	3	s	1	80	43	----	----	----	----
----	----	----	----	----	----	s w	2	s w	7	s w	1	84	50	----	----	----	----
80	Cir. Str.	----	----	----	----	s w	5	n w	6	n w	3	66	37	----	----	----	----
----	----	----	----	----	----	n w	1	n w	3	n	2	66	30	----	----	----	----
----	----	----	----	----	----	s e	2	s e	2	s	3	76	42	----	----	----	----
----	----	----	----	----	----	s w	2	s w	4	----	0	84	40	----	----	----	----
----	----	----	----	----	----	s e	2	s w	4	----	0	89	48	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	.80	----
25	----	24	----	8	----	----	----	----	----	----	----	78.70	48.10	----	----	----	----
			19			----	----	----	----	----	----	----	----	----	----	----	----

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent. of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	59	89	53	67	70	59	93	.352	.809	.375	29.359	29.286	29.409	29.391
2	47	73	41	53⅔	92	72	100	.298	.581	.257	29.467	29.439	29.492	29.466
3	50	73	54	59	100	77	93	.361	.617	.390	29.536	29.431	29.488	29.485
4	49	79	60	62⅔	92	62	71	.322	.612	.367	29.464	29.339	29.239	29.347
5	63	80	58	67	72	62	88	.416	.638	.423	29.066	28.930	29.038	29.011
6	46	63	54	54⅓	92	77	87	.286	.446	.362	29.119	29.070	28.948	29.046
7	45	59	42	48⅔	92	70	83	.275	.352	.222	29.194	29.210	29.218	29.207
8	47	66	44	52⅓	85	49	92	.273	.316	.265	29.095	28.921	29.101	29.039
9	46	54	43	47⅔	77	87	92	.238	.362	.254	29.373	29.341	29.317	29.344
10	39	60	51	50	82	88	93	.195	.456	.348	29.254	29.019	28.889	29.054
11	60	70	60	63⅓	94	80	94	.487	.586	.487	28.740	28.601	28.563	29.635
12	52	57	39	49⅓	93	69	100	.361	.322	.238	28.800	28.980	29.234	29.671
13	38	61	52	50⅓	91	83	93	.208	.442	.361	29.455	29.434	29.359	29.416
14	56	80	62	66	87	70	83	.391	.717	.460	29.314	29.241	29.208	29.254
15	70	84	73	75⅔	85	72	85	.621	.832	.693	29.314	29.226	29.210	29.250
16	71	65	41	59	80	84	100	.608	.516	.257	29.119	29.199	29.417	29.245
17	38	54	40	44	81	87	100	.186	.362	.248	29.539	29.527	29.516	29.527
18	40	59	47	48⅔	82	76	85	.203	.380	.273	29.460	29.359	29.264	29.361
19	48	72	54	58	100	76	100	.335	.595	.418	29.140	29.0 8	28.997	29.048
20	50	54	46	50	100	100	100	.361	.388	.311	28.969	28.946	28.958	28.958
21	50	53	48	50⅓	100	100	100	.361	.403	.335	28.970	28.981	29.054	29.002
22	49	51	42	47⅓	92	93	100	.322	.348	.267	29.180	29.219	29.299	29.233
23	43	57	41	47	100	94	100	.278	.436	.257	29.374	29.353	29.326	29.351
24	47	62	42	50⅓	100	88	100	.323	.491	.267	29.317	29.231	29.232	29.260
25	33	63	41	45⅔	89	83	100	.168	.478	.257	29.234	29.185	29.160	29.193
26	37	59	41	45⅔	100	88	100	.221	.439	.257	29.212	29.157	29.256	29.208
27	46	63	46	51⅔	100	83	100	.311	.478	.311	29.294	29.128	29.053	29.158
28	50	57	47	51⅓	93	94	85	.335	.436	.273	28.918	28.909	28.968	28.932
29	31	45	35	37	100	84	90	.174	.251	.183	29.051	29.014	28.961	29.009
30	41	54	40	45	91	93	100	.235	.390	.248	28.901	28.985	29.005	28.947
31	38	55	50	47⅔	91	87	93	.208	.376	.335	29.024	28.999	28.978	29.000
Sums	-----	-----	-----		----	---	-----	-----	-----	-----	-------	-------	-------	--------
Means	----	-----	----	53.06	90.42	80.23	93.55	.313	.479	.333	-------	-------	-------	29.227
Average	------	------	------	----		88			.375		----	------	--------	--------

Oct. 6.—Thunder shower in evening.

OCTOBER, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds,						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		9 P. M.		9 P. M.							
Per cent of c'oud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
40	Cir. Str.	----	--------	----	--------	w	1	w	5	n	2	89	41	--------	--------	------	------
100	Cir.	----	--------	----	--------	n e	2	s e	3	s e	1	74	38	--------	--------	------	------
Fog	Fog.	----	--------	----	--------	s e	3	s e	----	s e	----	74	43	--------	--------	------	------
----	--------	----	--------	----	--------	s e		s	6	s w	5	80	48	--------	--------	------	------
30	Cir. Str.	----	--------	----	--------	s w	10	s w	11	n	4	80	43	--------	--------	------	------
----	--------	100	Nim.	60	Cir.	n w	6	w	4	n w	9	66	42	2 p. m.	4 p. m.	.11	------
60	Cir. Str.	20	Cir.	----	--------	n w	3	n w	3	n w	4	62	39	--------	--------	---	------
100	Nim.	100	Cir.	----	--------	w	8	s e	9	s e	4	68	32	9:20a.m	11 a. m.	.05	------
20	Cir.	----	--------	----	--------	e	3	e	2	s e	2	58	33	--------	--------	------	------
----	--------	20	Cir.	20	Cir.	s e	3	s w	11	s w	9	64	42	--------	--------	----	------
100	Cir. Cu.	100	Cu. Nim.	100	Nim.	s w	6	s w	8	s w	11	69	52	3:30p.m	In night.	1.22	------
----	--------	40	Cir. Cu.	----	--------	s w	---	w	10	w	1	58	33	--------	--------	------	------
20	Cir.	40	Cu.	----	--------	---	0	s e	9	s	7	66	37	--------	--------	------	------
40	Cir.	40	Cir. Cu.	----	--------	s w	5	w	12	s w	8	84	57	--------	--------	------	------
----	--------	40	Cu.	40	Cir.	s w	9	s w	10	s w	8	86	68	--------	--------	------	------
50	Cir. Cu.	100	Cu.	----	--------	s w	9	n w	8	n w	2	75	31	--------	-------	-----	------
----	--------	----	--------	----	--------	----	0	e	2	s	1	56	32	--------	-------	-----	------
60	Cir. Str.	----	--------	----	--------	----	0	s e	4	s e	4	59	37	--------	--------	------	------
40	Cir.	----	--------	100	Nim.	s e	4	s e	9	w	2	74	47	5 p. m.	In night.	.47	------
Fog	Fog.	100	Cir. Str.	80	Cir.	w	3	w	7	w	4	57	44	--------	--------	-----	------
80	Cir.	60	Cu. Nim.	----	--------	w	5	w	3	w	5	56	44	12:30p.m.	5 p. m.	.14	------
100	Cir.	100	Cir.	----	--------	n w	4	----	0	n w	1	52	35	--------	--------	------	------
Fog	Fog.	----	--------	----	--------	n w	1	n w	5	n w	2	57	39	--------	--------	------	------
Fog	Fog.	----	--------	----	--------	n w	1	n w	----	n e	----	64	31	--------	--------	------	------
----	--------	----	--------	----	--------	n e	----	s e	2	----	0	66	32	--------	--------	------	------
Fog	Fog.	----	--------	----	--------	s e	1	s e	2	----	0	63	33	--------	--------	-----	------
Fog	Fog.	50	Cir.	----	--------	----	0	s e	1	s	1	66	43	--------	--------	------	------
30	Str.	100	Cir.	---	--------	s w	3	w	7	w	2	59	30	--------	--------	------	------
80	Str.	80	Cir. Str.	40	Cir.	----	0	w	4	e	1	40	31	--------	--------	------	------
40	Str.	---	--------	--	--------	s e	7	s e	3	s e	1	57	30	--------	--------	------	------
100	Cir.	80	Cir.	100	Nim.	s e	2	s e	5	w	7	57	37	*	†	.02 .14	------
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	-----	--------	--------	2.15	------
34	--------	38	--------	17	--------	----	---	----	----	----	----	65.87	39.48	--------	-------	------	------
30						----	----	----	----	----	----	------	------	--------	--------	--- -	------

* 8:30 a. m.; 7 p. m. † 10:30 a. m.; in night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of Month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	45	49	47	47	84	92	92	.251	.322	.298	28.994	28.965	28.949	28.969
2	42	51	38	43⅔	91	100	91	.244	.374	.208	28.885	28.818	28.910	28.871
3	29	59	40	42⅔	100	70	91	.160	.352	.225	29.106	29.135	29.205	29.149
4	40	60	50	50	91	71	85	.225	.367	.309	29.178	29.077	29.009	29.088
5	50	51	43	48	78	100	92	.283	.374	.254	28.827	28.730	28.910	28.822
6	38	45	27	36⅔	91	84	100	.208	.251	.147	29.135	29.204	29.275	29.205
7	37	43	42	40⅔	71	92	91	.157	.254	.244	29.218	29.144	29.022	29.128
8	43	43	42	42⅔	92	83	91	.254	.231	.244	28.860	28.800	28.705	28.788
9	43	43	38	41⅓	92	83	91	.254	.231	.208	28.652	28.824	28.981	28.819
10	37	48	49	44⅔	100	78	57	.221	.260	.199	28.920	28.841	28.660	28.807
11	38	38	32	36	91	100	100	.208	.229	.181	28.597	28.655	28.941	28.731
12	30	36	28	31⅓	100	71	100	.167	.149	.153	29.101	29.191	29.264	29.185
13	28	40	29	32⅓	64	56	100	.099	.139	.160	29.371	29.344	29.325	29.347
14	33	45	40	39⅓	89	84	91	.168	.251	.225	29.188	28.998	28.954	29.047
15	52	59	46	52⅓	100	100	84	.388	.500	.262	28.961	28.989	29.061	29.003
16	34	36	26	32	89	80	87	.175	.170	.123	29.249	29.374	29.512	29.378
17	23	33	24	26⅔	100	80	100	.123	.150	.129	29.562	29.552	29.575	29.563
18	25	33	31	29⅔	100	80	100	.135	.150	.174	29.585	29.502	29.315	29.467
19	33	49	36	39⅓	80	71	90	.150	.247	.191	29.127	29.035	28.984	29.049
20	41	58	53	50⅔	82	76	80	.212	.365	.321	28.935	28.869	28.858	28.887
21	47	45	33	41⅔	92	84	89	.298	.251	.168	28.935	29.109	29.304	29.116
22	28	30	24	27⅓	88	100	100	.135	.167	.129	29.311	29.223	29.205	29.246
23	19	25	19	21	100	87	84	.103	.117	.087	29.345	29.381	29.368	29.365
24	19	25	33	25⅔	84	100	80	.087	.135	.150	29.366	29.295	29.178	29.280
25	38	39	41	39⅓	91	100	100	.208	.238	.257	29.091	29.071	28.919	29.027
26	50	37	29	38⅔	100	100	88	.361	.221	.142	28.742	28.808	29.230	28.927
27	25	29	20	24⅔	87	100	85	.117	.160	.091	29.435	29.457	29.504	29.465
28	24	39	24	29	100	73	100	.129	.173	.129	29.459	29.274	29.138	29.290
29	20	19	19	19⅓	100	100	84	.108	.103	.087	29.277	29.358	29.428	29.354
30	15	23	25	21	100	100	87	.086	.123	.117	29.405	29.301	29.066	29.257
Sums														
Means				36.49	90.90	86.50	90.33	.190	.235	.187				29.154
Average						89.24			.204					

NOVEMBER, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Nim.	100	Cir.	100	Cir.	n e	3	n e	7	n e	9	51	41	--------	--------	----	------
100	Cir.	50	Cir.Str.	----	--------	n	8	n	9	n	3	53	27	--------	--------	------	------
----	--------	--	--	----	----	s	2	s	9	s	4	61	29	--------	--------	------	------
----	--------	10	Cir.	80	Cir.	s	5	s	11	s	6	63	39	----	--------	--	------
100	Cir.Str.	100	Nim.	100	Nim.	s	10	s w	16	s w	13	53	37	10 a.m.	5 p. m.	.20	------
80	Cir.	60	Cir.	30	Cir.	w	13	w	10	----	1	47	26	--------	----	------	------
100	Cir.	80	Cir.	100	Nim.	s w	5	s e	7	s e	5	43	36	9 p. m.	In night.	.04	------
100	Nim.	100	Cir.	100	Nim.	e	2	n e	2	n	4	43	37	8 p. m.	--------	----	------
100	Nim.	60	Cir.	100	Cir.	n	7	n	6	n	2	44	31	-------	8 a. m.	.40	------
100	Cir.	80	Cir.Str	100	Nim.	n	8	s w	14	s	16	50	36	8:30 p m	In night.	.15	------
80	Cir. Cu.	100	Nim.	100	Nim.	s	9	n w	12	n	11	38	28	*	‖	.06	------
60	Cir.	60	Cir.	30	Str.	w	10	n w	10	w	3	37	19	--------	-------	----	------
30	Cir.Str.	30	Cir.	60	Str.	s w	2	w	5	----	0	40	25	--------	-- --	-	------
100	Nim.	100	Nim.	100	Nim.	----	0	s e	4	s e	5	52	33	†	§	.10	------
100	Nim.	100	Nim.	100	Nim.	s e	3	s e	6	n w	2	59	33	4 p. m.	In night.	.50	------
100	Cir.	50	Cir Cu.	----	--------	n w	5	n w	10	n w	4	38	20	--------	--------	------	------
100	Cir.	100	Cu. Nim.	----	--------	----	0	s w	8	s w	1	33	22	--------	--------	------	------
100	Cir.	100	Cir.	----	--------	s e	2	s w	8	s e	5	35	25	--------	--------	------	------
100	Cir.	40	Cir.	----	--------	s	7	s w	7	s	4	51	32	--------	-------	------	------
60	Cir.	60	Cir.	----	--------	s	8	s w	14	s	13	60	40	--------	--------	------	------
20	Cir.	100	Cir.	----	--------	w	6	n e	6	n e	4	49	25	--------	--------	------	------
80	Cir.	100	Nim.	---	--------	n e	3	n	4	n e	5	30	18	‡	‡	----	------
30	Str.	100	Cir.	---	----	n w	5	e	8	s	7	26	16	---	--------	--	------
20	Str.	--	--------	60	Cir.	s w	5	s e	8	s e	10	49	18	In night.		.09	-----
100	Nim.	100	Nim.	100	Nim.	s	7	s	7	s	5	50	38	In night.	--------	------	------
100	Nim.	100	Nim.	60	Cir.	s	6	n w	7	n w	8	51	24	--------	2 p m.	.70	-----
50	Cir.	30	Cir.	---	--------	n w	4	n w	9	n w	1	36	18	--------	-------	------	------
60	Str.	---	--------	----	--------	s e	4	s e	6	n w	2	39	20	--------	--------	------	------
100	Cir.	65	Cu.	---	----	w	11	w	11	w	8	21	15	-------	--------	------	------
30	Str.	85	Cu.	100	Cir.	n w	1	s w	8	w	6	26	15	In night.	Snow.	.10	1
----	--------	----	--------	----	--------	----	----	----	----	----	----	------	------	-------	--------	2.94	1
72	--------	69	--------	48	--------	----	----	----	----	----	----	44.27	27.43	-------	--------	------	------
63						----	----	----	----	----	----	------	------	-------	--------	------	------

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* 10 a. m., snow flurries.
† 8 a. m. In night.
‡ Snow flurries.
‖ 2 p m., snow flurries
§ 11:30 p. m. In night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
1	25	27	7	19⅔	87	100	100	.117	.147	.060	28.966	29.096	29.354	29.139
2	11	27	25	21	100	100	100	.071	.147	.135	29.475	29.454	29.485	29.471
3	22	30	26	26	100	100	100	.118	.167	.141	29.544	29.468	29.348	29.453
4	30	33	31	31⅓	100	100	89	.167	.188	.155	29.027	28.827	28.678	28.844
5	24	38	26	26	86	100	100	.111	.153	.141	28.818	28.981	29.080	28.960
6	23	30	32	28⅓	100	89	89	.123	.148	.162	29.058	28.881	28.793	28.911
7	32	31	28	30⅓	100	100	88	.181	.174	.135	28.976	29.088	29.172	29.079
8	27	43	31	33⅔	100	83	100	.147	.231	.174	29.071	28.994	29.073	29.046
9	37	50	50	45⅔	90	100	100	.199	.361	.361	29.083	29.068	29.058	29.070
10	52	53	49	51⅔	93	93	100	.361	.375	.348	29.020	28.950	28.868	28.946
11	37	39	35	37	100	100	100	.221	.238	.204	29.020	29.091	29.082	29.064
12	33	36	33	34	100	100	100	.188	.212	.188	29.076	29.061	29.121	29.086
13	33	39	34	35⅓	100	100	100	.188	.238	.196	29.151	29.096	28.891	29.046
14	36	43	39	39⅓	100	100	91	.212	.278	.216	28.770	28.733	28.793	28.765
15	34	38	35	35⅔	89	91	90	.175	.208	.183	28.926	29.003	28.965	28.965
16	38	25	20	27⅔	91	100	100	.208	.135	.108	28.930	29.122	29.329	29.127
17	19	18	13	16⅔	100	100	100	.103	.098	.078	29.253	29.179	29.323	29.252
18	11	15	-3	7⅔	100	100	100	.071	.080	.038	29.517	29.497	29.553	29.522
19	-3	19	17	11	74	100	100	.041	.103	.094	29.581	29.483	29.389	29.484
20	20	27	23	23⅓	100	100	100	.108	.147	.123	29.110	28.928	29.026	29.021
21	20	30	20	23⅓	100	100	100	.108	.167	.108	29.074	29.043	28.931	29.016
22	10	22	12	14⅔	100	100	100	.068	.118	.075	28.885	28.877	28.871	28.878
23	14	10	2	8⅔	100	100	100	.082	.068	.048	28.912	29.067	29.253	29.077
24	-13	17	10	4⅔	100	100	100	.025	.094	.068	29.474	29.452	29.344	29.423
25	20	20	31	23⅔	85	85	89	.091	.091	.155	29.069	28.994	29.013	29.025
26	25	25	21	23⅔	87	100	85	.117	.135	.096	28.997	28.998	29.073	29.023
27	11	21	1	11	100	100	100	.071	.113	.046	29.220	29.260	29.299	29.260
28	14	26	18	19⅓	81	100	84	.067	.141	.082	29.360	29.323	29.236	29.306
29	28	34	37	33	100	89	81	.153	.175	.178	28.870	28.633	28.763	28.755
30	35	35	30	33⅓	90	100	100	.183	.204	.167	28.785	28.836	28.979	28.867
31	22	21	10	17⅔	100	100	100	.118	.113	.068	29.002	29.029	29.144	29.058
Sums														
Means				25.62	95.26	97.74	96.32	.135	.169	.140				29.095
Average					96.44			.148						

DECEMBER, 1897, AT AGRICULTURAL COLLEGE, MICHIGAN.

Clouds.						Winds.						Registering thermom'r		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning rain or snow.	Ending rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	Nim.	80	Cir.	----	----	w	5	n w	5	w	1	30	3	----	----	----	----
80	Cir.	100	Cir.	100	Cir.	----	0	s w	4	w	3	30	11	----	----	----	----
50	Cir.	85	Cu.	100	Cir.	n e	4	n e	4	n e	4	30	22	In night.	----	----	----
100	Nim.	100	Nim.	100	Nim.	n e	4	n e	6	w	15	33	23	----	8:00 am	.26	----
100	Nim.	100	Nim.	35	Cir.	s w	10	s w	7	s w	2	27	15	----	----	----	----
100	Cir.	100	Cu.	100	Nim.	s w	10	s w	14	s w	14	34	25	†5:30pm	8:00 pm	.19	1½
100	Cir.	100	Cir.	100	Cir.	s w	3	s w	9	s w	5	33	25	----	----	----	----
20	Cir.	20	Cir.		----	s e	6	s e	3	s e	3	44	27	----	----	----	----
--	----	100	Cu.	100	Cir.	s e	2	s e	6	s e	6	54	35	In night.	----	----	----
100	Nim.	100	Nim.	100	Nim.	s e	11	s e	9	s e	2	52	37	----	In night.	.63	----
100	Cir.	100	Nim.	100	Cir.	s e	4	e	4	e	2	40	32	----	----	----	----
100	Cir.	100	Cir.	100	Cir.	--	0	s	2	s	3	36	32	----	----	----	----
100	Cir.	80	Cir	100	Nim.	s e	2	e	4	e	5	39	33	8:00 pm	In night.	.14	----
100	Nim.	100	Nim.	100	Cir.	e	3	e	8	e	2	43	34	----	----	----	----
100	Cir.	100	Cir.	100	Cir.	w	5	w	8	w	10	40	33	----	----	----	----
40	Cu.	50	Cu.	----	----	s w	18	n	16	n e	5	38	19	In night.	----	----	----
100	Nim.	20	Cir.	----	----	n	3	n w	8	n w	9	30	11	----	11:00am	.52	3½
30	Str.	50	Str.	--	----	n w	7	w	5	n w	----	20	−7	----	----	----	----
50	Cir.	50	Cir.	100	Cir.	n w	----	n w	4	n	4	20	-3	--	----	----	----
100	Nim.	100	Nim.	100	Cir.	e	2	n e	1	n e	3	30	11	†6:00am	8:00 am	----	----
100	Cir.	100	Cir	--	----	n e	1	s e	7	s w	6	32	10	----	----	----	----
50	Cir.	60	Cir.	--	----	s w	9	s w	12	s w	11	24	9	----	----	----	----
100	Nim.	100	Nim.	----	----	s w	3	n w	14	n w	6	17	−13	----	----	----	----
--	----	35	Cir.		----	n	1	s w	7	s w	8	20	10	----	----	----	----
20	Str.	100	Cir.	100	Cir.	s w	15	s w	12	s w	7	32	10	----	----	----	----
90	Cir.	100	Cir.	100	Cir.	n w	3	s w	13	w	2	30	11	----	----	----	----
60	Nim.	--	----	--	----	n w	2	n w	3	----	0	22	0	----	----	----	----
100	Cir.	50	Cir.	50	Cir.	s e	3	s w	7	s w	4	29	12	*	12 noon	----	----
100	Cir.	100	Cir	100	Cir.	s	15	s	18	s	11	38	28	†8:00am	--	.28	----
100	Cir.	100	Nim.	80	Cir.	s w	8	w	7	n w	4	37	20	†6:00am	9:00 am	----	----
100	Nim.	60	Cir.	----	----	n	5	n	6	n	4	23	2	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	2.02	5
77	----	79	----	60	----	----	----	----	----	----	----	32.16	16.65	----	----	----	----
		72				----	----	----	----	----	----	----	----	----	----	----	----

† Snow. * Snow in night.

BULLETINS

OF THE

AGRICULTURAL COLLEGE EXPERIMENT STATION

ISSUED DURING THE

YEAR ENDING JUNE 30, 1898.

EXPERIMENT STATION BULLETINS.

COMMERCIAL FERTILIZERS.

R. C. KEDZIE.

Bulletin 145, Chemical Department.

COMMERCIAL FERTILIZERS A MODERN PRODUCT.

Concentrated manures as commercial articles are very modern and were unknown fifty years ago. Their starting point was the suggestion of Liebig, that bones could be made more active by treating them with sulphuric acid. This was in 1840; J. B. Lawes of Rothamsted, Eng., took advantage of the hint by using the acid to convert mineral phosphates into soluble or superhosphates, about 1850, and the manufacture of superphosphates and other artificial manures on the commercial scale was soon established and grew to vast proportions, laying the foundation for the large fortune which has enabled Sir J. B. Lawes to endow the Experimental Farm of Lawes & Gilbert at Rothamsted. Thus commercial fertilizers laid the foundation of the greatest experiment station in the world.

One reason why superphosphates came so speedily into favor with British farmers was the special beneficial influence in the growth of the turnip crop—the special manurial crop in British agriculture. They found that superphosphates greatly promoted the growth of the turnip in its earliest growth, carrying the plant beyond its critical stage before the true leaves are formed at which time it is liable to be destroyed by the turnip fly. In the English system of rotation of crops, the turnip is the manurial crop, on which the other crops in the rotation depend, occupying in British agriculture about the same position that red clover does with us. Hence the early favor and great popularity of these concentrated manures in England.

In this country the introduction of concentrated manures has been slower for two reasons: 1, we have no such specialized crop as the turnip which becomes the pivot of the whole rotation and for which a concentrated manure is almost indispensable; 2. The virgin soils of our country do not make such demands for special manures as do the soils of the old world, depleted by centuries' constant cropping. In the new lands of our State, which have practically lain fallow for a thousand years, the need of new supplies of potash, nitrogen and phosphorus is not so manifest, hence the introduction of commercial fertilizers has been slow and halting, yet it is probable that by the present system of soil depletion and neglect to preserve the natural fertility of our lands by rotation of crops and selling only the finished and most costly products of the farm, the use of commercial fertilizers will soon become an urgent necessity.

WHAT DO COMMERCIAL FERTILIZERS CONTAIN?

The first question one asks about a new article is, "What is it made of?" and the second is, "Will a material of such composition and at the stated cost, give me a profit when used on my farm?"

Commercial fertilizers contain a variety of substances, but only three of such importance that the farmer can afford to buy them at the prices charged for concentrated manures. They often contain lime, magnesia, silica, oxide of iron, sulphates, chlorides, etc., many of these of value as manures, but they can be bought for less money than is charged for the commercial fertilizers. The fertilizers may contain all these, but we buy them because they contain in addition one or more of three materials, viz., potash, phosphoric acid, and active nitrogen. It is the presence of these materials that gives commercial value to fertilizers. If the dealer boasts that his manure also contains alumina, silica, oxide of iron, lime and magnesia, the sufficient answer is that these materials make up the mass of all soils, and that the farmer buys his land by the acre and not by the ton. The only manural materials that a farmer can afford to buy at prices demanded for fertilizers are these three most necessary, most precious, and most easily exhausted elements of plant growth—the tripod of agriculture. In the absence of any one of these three materials no plant can grow to perfection, and if the supply of them is below the needs of any given plant, that deficiency limits the crop proportionally. However, abundant all the other elements of plant life, nothing will make up for the lack of any one of these three substances.

WHERE FOUND?

In every good soil. The amount may vary in different soils, but every soil that can produce any crop contains some of these materials. A consideration of the composition of representative soils in our State may throw some light on this subject.

In former years the chemical department of this college spent much time and toil in gathering specimens of leading soils from all parts of our State, analyzing them, and mounting them in glass jars for exhibition, the jars bearing labels to show the locality from which the soil came, the kinds of timber growing on the land, and a chemical analysis of the soil. A set of 38 such mounted speciments was exhibited at the Columbian Exposition in Chicago, for which a bronze medal was awarded.

These specimens of soil and the medal can be seen at the chemical laboratory.

An effort was thus made to show the chemical composition of leading soils in our State, and to afford a basis for estimating their agricultural capabilities.

RESULTS OF SOIL ANALYSES.

The results were published in Bulletin 99, issued in 1893, and given to the public for their information. It is not proposed to republish these table of analyses, but by a condensed statement of such results it is possible that a lesson may be drawn regarding the fertilizers that may give the best results on the different soils. I present tables giving the chemical composition of soils of related agricultural capacity, without regard to their geographical distribution. In one table are placed the results of analysis of nine soils well adapted to the growth of winter wheat and some other grains. This table includes the mineral elements most active in plant growth, such as lime, potash, magnesia and phosphoric acid; it also includes sand and insoluble silicates, which are mere physical agents of growth.

The average of these nine wheat soils gives:

		Per cent.
Essential to plant growth.	Lime	1.68
	Magnesia	.54
	Potash	1.48
	Phosphoric acid	.38
Sand and insoluble silicates		70.43

Fruit Soils.—While the wheat soils will raise good fruit and produce hardy trees, there are soils in this State especially adapted to raising fruit, especially peaches and other stone fruits.

The analysis of nine such soils in widely separated localities gives the following average composition:

		Per cent.
Essential to plant growth.	Lime	1.15
	Magnesia	.51
	Potash	1.35
	Phosphoric acid	.26
Sand and insoluble silicates		83.75

Potato Soils.—A third class of soils might be described as gravelly or sandy loams, constituting the soils so celebrated for raising potatoes of excellent quality, and hence called "potato soils." They will also raise many other crops, and might be named "potato and general utility soils." They are found in large quantity in the northern counties bordering on the lakes, but are also found in some inland counties. The average composition of nine soils of this class gives the following results:

		Per cent
Essential to plant growth.	Lime	.93
	Magnesia	.38
	Potash	1.12
	Phosphoric acid	.22
Sand and insoluble silicates		90.02

The physical qualities of these soils contribute to their productiveness, permitting a wide range of roots in the soil and subsoil.

Light Sands.—There is a fourth class of soils, characterized by a large excess of sand, open and porous, in many cases easily drifted by the wind, the grass growing in bunches instead of an even sward, and the vegetation generally of a light character. The jack pine plains of the northern counties are good examples. Seven samples of such sandy soils give this average composition:

		Per cent.
Essential to plant growth.	Lime	.31
	Magnesia	.17
	Potash	.42
	Phosphoric acid	.09
Sand and insoluble silicates		92.66

By grouping in one table all these averages, we can better see their relation to each other, and their possible needs of fertilizers.

	Lime.	Magnesia.	Potash.	Phosphoric acid.	Sand and insoluble silicates.
Wheat and grain lands	1.68	.54	1.48	.38	70.43
Fruit soils	1.15	.51	1.35	.26	83.75
Potato and utility soils	.93	.38	1.12	.22	90.02
Sandy soils	.31	.17	.42	.09	92.66

One is struck with the steady increase of the sand and insoluble silicates as the eye follows down the table, and the nearly uniform decrease of the essential elements of plant food, the alkaline materials and phosphoric acid. Equally significant is the relatively small amount of the essential ash elements in these soils, taken as a whole, as compared with the inert materials in the soils. Take the average of the phosphoric acid in this group of soils, and it is less than one-fifth of one per cent. Now, an acre of soil taken to the depth of twelve inches would weigh 4,000,000 pounds. If such soil holds only one-fifth of one per cent of phosphoric acid an acre one foot deep would contain 8,000 pounds, or enough for 350 crops of wheat with the straw.

A glance at this table would suggest the mineral materials that it would be desirable to add to the soil to improve its productive capacity. If a soil is deficient in lime, the natural remedy would be to apply lime, or marl to tone up its composition. If the land is deficient in potash we may add wood ashes or German potash salts. It is found that a soil relatively deficient in potash will give better results by a good dose of lime, which renders active the inert forms of potash in the soil.

But the question arises, Why apply manures to the soil when it already contains such enormous quantities of mineral matter, even when the percentage is small. A soil that contains one per cent of lime holds enough of that element to supply a grain crop for a thousand years in succession.

Why add more to abundance? Why not use the material now on hand? There is much in the suggestion. The best warfare is not by hiring mercenaries, but by "calling out the reserves." It is for this purpose that many of the operations on the farm are carried on. For this we ditch and drain, plow and drag, hoe and cultivate, grind the ground by the roots of plants or the splitting wedge of frost, or open up the soil to air and sun to secure the action of oygen, "the tooth of time" that gnaws at rock and pillar till they are finally reduced to formless dust. It is by accelerating and augmenting the natural but slow changes in the mineral matter in the soil that the reserve materials in the soil are made active and available for plants by making them soluble. The cheapest way to fertilize a soil in ash materials is to make the soil feed itself by making active the reserve compounds of lime, magnesia, potash and phosphoric acid existing in the land. Most of the labor on the farm, aside from sowing and harvesting the crops, while performed for other purposes, contributes indirectly to this end, and is valuable largely for this purpose. The soil is a bank of deposit, and the wise farmer has learned how to draw out the deposits and put them in circulation in growing crops.

NAMES OF FERTILIZERS.

In most trades the manufacturers select some distinctive name for their goods, and often some name that shall mark the especial value and uses for the goods. In the same way manufacturers of fertilizers avail themselves of the customs of the trade in naming their products. They must have a name, and if it has a suggestive title that will attract the attention of the farmer and gardener, all the better. But we are not to assume that a "corn fertilizer," "potato fertilizer," or "cabbage fertilizer" is only good for this particular crop, and is essential for its growth. Often the name is a catch phrase.

Discarding the trade names, we may stop to ask, what is a commercial fertilizer? There are 13 elementary substances always found in plants grown under natural conditions; three of these are furnished by the air, nine come entirely from the soil and one (nitrogen) is furnished by air and soil. The 9 mineral elements are found in every soil capable of growing a plant, and most of them in inexhaustible quantities for plant uses. But there are 3 elements that exist in relatively small quantities in the soil, that are taken up in comparatively large amounts by the plant, and consequently are soonest exhausted by cropping, and where their supply in the soil is much reduced, profitable cropping is no longer possible, and the land is said to be exhausted. These three materials are nitrogen, potash and phosphoric acid, and it is only these three fertilizing materials, as a rule, that the farmer and gardener can afford to buy to increase his crops. In one form of combination or another they constitute the bulk of all the commercial fertilizers in the market. When these materials are present in the soil in adequate amount and in a form available to the plant, and the physical conditions of the soil, the supply of water and the right temperature are secured, abundant crops may be expected. Most soils are so abundantly supplied with the other chemicals of growth that with a sufficient supply of these three materials on which plant growth is so dependent—this tripod of agriculture—cropping without exhaustion might be carried on to the end of time. In all the various kinds of commercial fertilizers these three substances in their various forms of combination demand exclusive attention, and it is the amount and condition of these that determine the value of any fertilizer.

LEADING KINDS OF FERTILIZERS.

The leading kinds of fertilizers may be classified as follows:

1. *Complete Manure*, which contains nitrogen in some combination, such as a salt of ammonia, nitrate of soda, or organic nitrogen; potash, as muriate or sulphate (German Stassfurth salts) or wood ashes; and phosphoric acid as a phosphate of lime. It is called a complete manure because it contains all of the three materials most essential for plant growth, and most likely to be deficient in a field after long cropping.

2. *Plain Phosphate*, which may be in the form of superphosphate, soluble in water or solution of citrate of ammonia, these being called available, because they are readily taken up by the roots of plants; and ground phosphate rock, an insoluble form. The bone phosphate and rock phosphate are changed into superphosphate by the action of sulphuric acid, removing a part of the lime, as sulphate.

The soluble phosphate is especially beneficial to plants in the early state of their growth, giving them a good start. In later stages of growth when the plant by its roots can forage for food in the soil, the insoluble phosphate may have nearly as beneficial an effect.

Phosphates promote the formation of flower and fruit and secure earlier ripening. They may wisely be used on vines and succulent fruits that are liable to be cut by early frosts in autumn, securing early crops with better prices and avoiding the loss of the entire crop by untimely frosts before the most of the crop had ripened. Fruit trees sometimes blossom year after year without producing fruit. This is often caused by storms at the period of flowering, but it may be caused by constitutional weakness, in consequence of which pollen of vital power is not formed. In such cases the use of active phosphates is worthy of trial.

3. *Bone Meal* contains phosphate of lime and animal matter rich in nitrogen, and hence is very valuable for manure where we desire a prolonged influence. It is well adapted to grass lands and lawns, and is free from the bad odor often given off by mixed fertilizers. Moist meadows are benefited by a dressing of bone meal. If the bones that now adorn the back yard and pasture lot should be ground into a powder and scattered on a crop-worn field, the results would surprise some farmers.

4. *Potash Manures.* The best and cheapest is that neglected home product—wood ashes. These contain an average of five per cent of potash, besides a sensible amount of phosphate, and a very large amount of carbonates of lime and magnesia; they are an all-around plant manure so far as mineral matter is concerned, supplying each ash element.

Unless the farmer can bring into a active form the great store of potash in his soil, he will then have to buy the German potash salts, the muriate or sulphate. These salts are yearly coming into greater prominence as potash fertilizers, but their sale in Michigan in separate form has not been large.

The influence of potash on plant life is masterful; no plant can grow without it, and its influence in developing the carbohydrates, and maturing fruits, is marked and apparently controlling.

5. *Nitrogen Compounds.* Nitrogen is the bottled wine of the vegetable feast. If the term stimulant can be applied to any organization destitute of a nervous system, then nitrogen is the stimulant of plant life. In any of its combined forms it gives depth of color and exuberance of growth to vegetable life, and when in abundant supply it causes the plant to break forth into riotous growth. The great reservoir of nitrogen is the air, but the leaves of plants though constantly bathed in nitrogen, cannot drink in a particle. It is only *nitrogen in combination* that can be appropriated by the plant, and this enters the plant by the roots and comes from the soil. A small amount is brought to the soil by the rain, washing out the ammonia and nitrates of the air, but the amount is not large, and entirely inadequate to supply a crop.

A large amount of active nitrogen in the form of nitrates is yearly formed in every well cultivated field, and this is the cheapest way of securing a supply of this costliest element of plant growth. The raising of leguminous crops, like the clovers, is the next cheapest way of securing a supply.

Combined nitrogen is purchased in three forms; salts of ammonia, nitrate of soda, and organic nitrogen in the form of dried blood, fish scraps, cotton seed meal, etc.

6. *Tankage,* is a complex and variable material obtained from the waste residues at the slaughter houses, the garbage collected by the scavengers in cities, etc. These materials are dried, the grease extracted in tanks and this tankage by itself, or mixed with phosphates, potash, etc., is sold as a fertilizer. It is mainly used to give bulk to the concentrated fertilizers made from bone and rock phosphate.

LIME.

Following nitrogen, potash and phosphoric acid, the next most important material is lime. In soils made by the decomposition of granite rocks, the soil is apt to be deficient in lime. This is manifest in the New England states. In most of the countries of our lower peninsula where the soil is classed in the drift formation, lime is an abundant element in the soil. It is easy to determine this by an examination of the well water. Our water comes by the rain, and is soft, but soaking into the ground it dissolves more or less of the mineral matter of the soil. If the well water of any region is *very hard* as shown by its action on soap, the hardness being caused by the lime dissolved in the water, such soil contains enough lime to supply the needs of crops. Lime may be used in such regions to decompose muck and flocculate clay, but is not required to feed the crops.

SHALL THE FARMER USE COMMERCIAL FERTILIZER?

An important question both for farmer and manufacturer. They cost money—a material not too abundant in the farmer's pocket in these times—while there is a large amount of valuable manurial material produced on the farm that costs nothing but a little labor and considerable care in collecting and keeping. The dealer offers a "complete manure," which furnishes three of the thirteen chemicals of agriculture, whereas stable manure contains "the baker's dozen," and may be called an *entire manure*, because it furnishes every material required by the plant. It also contains a large amount of organic substance, the decay of which furnishes the humus so necessary for the proper physical condition of the soil. If commercial fertilizers are used on the farm, experience teaches that only by combining their use with that of barnyard manure can permanent fertility be maintained. If used alone and without securing a supply of organic matter in the soil, it is found in the course of years that the land has fallen off in fertility, either from a change in the physical condition of the soil, or from a deficient supply of some material not included in the "complete fertilizer," but contained in the farm manure. If the commercial fertilizers of any kind are used, they should be employed along with barnyard manure, to supplement and reinforce the standard manure of successful farming, for the dung heap is the pivot of successful farming.

The college is often asked to analyze the soil of some farm to determine what is required to make it fertile. A handful of soil is caught up at random on some part of the farm and sent here for analysis, not realizing that skill and experience are required to make a selection of soil that fairly represents the field or farm as a whole. The analysis of such a random specimen, however, carefully made, may be of little or no value in determining the requirements of such a farm, "and yet shew I unto you a more excellent way." Question the soil as to its wants by actual trial. Ask it whether it wants this element, or would do better with that, by applying these manures to small plots and watching the results. If the crop is markedly improved by the use of the fertilizer on your plot, then you have reliable information from original sources, better than any the chemist can give you.

I was once walking with Secretary Howard and admiring the Blue Lupines that beautified our lawn before the advent of the lawn mower, and wondered whether it was a good food for stock. Secretary Howard answered my inquiry by throwing a handful to a sheep in the next field; the sheep quickly took in the situation and the lupines, licked its chops and looked up for more, saying as plain as words, "I like that, give me some more." In like manner question your soil by placing in it some one fertilizer and watch the result as shown by plants growing on it. If it answers you by waving its flag of brilliant green signaling you the message "that is what I want and can use to advantage; give me more." you have your answer. If it shows no sign of improved growth, you have your answer of another kind as to that material. The failure may be not from the nature of your fertilizer but from some physical defect in the soil or the season, but the same conditions would apply to the farm. Hence the answer of the plot would apply to the field.

ARE THEY STIMULANTS?

Some farmers regard commercial fertilizers as "stimulants and not nourishment," and that they exhaust the soil instead of feeding it. The elements in the concentrated manures are direct food for the plants, enabling them to appropriate not only the materials in such manures, but to use other matter in the soil that otherwise would remain useless. In this way they may "aid the farmer to exhaust the soil by rapidly removing in the crops, substances which the soil unaided can supply but slowly or insufficiently, and thus impair or destroy one or several of those conditions which are indispensable to plant production." (Prof. S. W. Johnson.) By putting farm manure in the forefront of the line of battle, and using the concentrated manures as the cavalry to protect the flanks and rear of the agricultural army, defeat may be averted and the field won and permanently held.

HOW, AND WHY BENEFICIAL?

Concentrated manures are used in doses varying from 100 to 500 pounds to the acre. Let us take the larger dose and estimate how much of the three especially active elements we add to the soil. The best complete manures contain a large amount of secondary materials produced in making a superphosphate. Such are sulphate of lime made by acting on bones or mineral phosphates by sulphuric acid, tankage and drying materials, etc., so that only about 300 pounds in a ton consist of the three special manurial elements. Thus, I find that 500 pounds of a very valuable fertilizer made in this state would contain of

Ammonia	15.65	pounds
Available phosphoric acid	45.35	pounds
Real potash	11.00	pounds
Active materials in 500 pounds	72.00	

By applying 500 pounds of such fertilizer we add to the 4,000,000 pounds of an acre of soil one part of ammonia in 256,000 parts of soil, one part of phosphoric acid in 90,000 parts of soil, and one part of potash in 364,000 parts. How can this trifling amount of fertilizer have any influence on the growth of a crop? There are many soils in this State which would receive no benefit from such an application of manure. Many virgin soils, the prairies and bottom lands of our rivers, would receive no benefit from such application of fertilizers because they contain in available form all the plant food that any crop can use; the table spread for the plant feast is loaded with every food and viand the plant can use, and enough is as good as a feast. The attempt to fill dishes already full would be futile.

It has been shown that the great mass of all soils is inert and inactive as plant food, that only a small per cent of the soil ever serves as food of plants, and the amount at any time available for the plant is still smaller, seldom exceeding one part in a thousand. It is only the part soluble in water or in weak acids that is available for the plant. When this small fraction is still further reduced, so that the plant does not find in all parts of the soil a full supply for all its needs, then fertility falls off, and in proportion to this reduction is the exhaustion of the soil. In such cases a supply of the needed material in a form soluble in the soil water and capable of being taken up by the roots of the plant may restore the conditions of fertility and arrest the exhaustion of the soil. It is mainly for the purpose of offering to the plant in immediately available form the deficient elements of fertility, and to supplement the food elements that exist in the soil in insoluble form, that concentrated manures are used for the most part. The concentrated manures are nourishment and in a form fitted for immediate use. But if these materials are in a form unavailable by the plant, or deficient in supply, then all the other elements of fertility will be correspondingly limited in action. Often the largest benefit secured by the use of these fertilizers is by their setting other substances at work in the soil which would otherwise remain inactive.

HOW COMMERCIAL FERTILIZERS ARE COLLECTED AND ANALYZED.

The law in force in this State on the inspection of commercial fertilizers requires that samples of fertilizers retailing for more than ten dollars a ton shall be gathered in the open market and analyzed under the direction of the State Board of Agriculture at least once a year. A representative of the chemical department visits various parts of the State and collects samples of all fertilizers he finds on sale. When a dealer has several packages of the same fertilizer a handful is taken from each bag, the whole well mixed, and then a pound taken for an average sample for analysis. On a card is entered the name and address of the manufacturers, the trade name of the fertilizer, the name and address of the dealer and date of collecting. This card is inclosed with the specimen in a tight can and brought to the laboratory for analysis. When all the speciments are collected, a careful analysis is made of each fertilizer to determine the amount of nitrogen in the form of a salt of ammonia, a nitrate or organic nitrogen; the amount of phosphoric acid, which is soluble in water, or in a solution of citrate of ammonia (reverted), and insoluble or mineral phosphate; and the potash soluble in water. In the Bulletin the results of anlysis are entered in a horizontal line, and in a parallel line the percentage amounts claimed of the same material by the manufacturer, thus admitting of ready comparison of the "claimed" and "found" composition.

TERMS EXPLAINED.

In the table giving the results of analysis of commercial fertilizers there are certain terms used which require explanation: "Available nitrogen, estimated as ammonia;" under "Phosphoric acid" the terms "Available $P_2 O_5$;" "Insoluble $P_2 O_5$;" Total $P_2 O_5$" and "Potash soluble in water, estimated as $K_2 O$."

Nitrogen may exist in available form either as a salt of ammonia, a nitrate, or in organic material such as dried blood, and be equally valuable in these several forms. But for ease of comparison in different manures chemists estimate it as if all these forms of nitrogen existed in the form of ammonia. Chemists estimate the compounds of phosphorus in manures as anhydrous phosphoric acid, $P_2 O_5$; that is, phosphoric acid deprived of water; when this anhydride combines with water, the acid is formed. Thus if three molecules of water are added to one of $P_2 O_5$ two molecules of phosphoric acid are formed $3H_2O + P_2 O_5 = 2 H_3 PO_4$ = phosphoric acid. The $P_2 O_5$ in separate form does not exist in any soil, but this expression is chosen because the amount of this combination of phosphorus is easily indicated, without considering what material the acid may be combined with. "Available $P_2 O_5$" signifies the per cent of the acid in a form directly usable by the plant: "Insoluble $P_2 O_5$," the per cent of acid in the condition of phosphate rock. By adding together the "Available" and "Insoluble" we get the "Total P_2O_5."

The "Potash soluble in water estimated as K_2O," is the soluble potash salt estimated only as regards the oxide of potassium = K_2O = oxide of kalium or potassium. Since potash is often used in the form of sulphate of potash (K_2SO_4), a second estimate is added of that combination, but the *real potash* in both columns is the same.

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Armour & Co., Chicago	All Soluble	Mohr Hardware Co., W. Bay City
Armour & Co., Chicago	Bone, Blood and Potash	B. F. Pixley, St. Joseph
Armour & Co., Chicago	Ammoniated Bone with Potash	L. F. Jones Seed Co., Grand Rapids
Armour & Co., Chicago	Grain Grower	Mohr Hardware Co., W. Bay City
Armour & Co., Chicago	Bone Meal	L. F. Jones Seed Co., Grand Rapids
James Boland, Jackson	Blackman	Manufacturer
Bradley Fertilizer Co., Boston	Ammoniated Dissolved Bones	Manufacturer
Bradley Fertilizer Co., Boston	B. D. Sea Fowl Guano	Richmond Elevator Co., Lenox
Bradley Fertilizer Co., Boston	Niagara Phosphate	Manufacturers
Bradley Fertilizer Co., Boston	Dissolved Bone with Potash	Richmond Elevator Co., Lenox
Bradley Fertilizer Co., Boston	Potato Fertilizer	Richmond Elevator Co., Lenox
Bradley Fertilizer Co., Boston	Abattoir Bone Dust	Manufacturer
Crocker Chemical Co., Buffalo	Vegetable Bone Superphosphate	Manufacturer
Crocker Chemical Co., Buffalo	New Rival Ammoniated Superphosphate	F. C. Goddeyne, Bay City
Crocker Chemical Co., Buffalo	Universal Grain Grower	F. C. Goddeyne, Bay City

for 1897, expressed in parts in a hundred.

	Available nitrogen.	Phosphoric acid.			Potash soluble in water.	
	Estimated as ammonia.	Available P_2O_5.	Insoluble P_2O_5.	Total P_2O_5.	Estimated as K_2O.	Estimated as K_2SO_4.
Claimed	3.5 to 4.5	8 to 10	1.5 to 2.5		4 to 5	
Found	3 67	9.36	1.59	10.95	5.18	9.57
Claimed	5 to 6	8 to 10	1.5 to 2.5		7 to 8	
Found	5 54	9.57	2.69	12.26	7.78	14.38
Claimed	3 to 4	6 to 8	1.5 to 2.5		2 to 3	
Found	3.35	8.67	1.77	10.44	2.93	5.42
Claimed	2 to 3	8 to 10	1.5 to 2.5		2 to 3	
Found	2.53	10.15	3.28	13.43	2.02	3.73
Claimed	3 to 4	10 to 14	13 to 15			
Found	4.49	15.03	9.09	24.12		
Claimed	.94	3.86	2.06	5.92	2.51	
Found	1.02	3.94	2.00	5.94	2.56	4.73
Claimed	2 to 3	7 to 9	1 to 2	8 to 11	1 to 2	1.85 to 3.70
Found	2.21	7.43	3.40	10.83	1.70	3.14
Claimed	2.5 to 3.5	8 to 10	2 to 3	10 to 13	1.5 to 2.5	2.75 to 4.75
Found	2.92	9.70	2.07	11.77	1.56	2.88
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2	1.85 to 3.70
Found	1.31	8.41	1.70	10.11	1.03	1.90
Claimed	1 to 2	8 to 10	2 to 3	10 to 13	2.15 to 3.25	4 to 6
Found	1.46	8.78	1.46	10.24	2.15	3.97
Claimed	2.5 tb 3.5	9 to 11	2 to 3	11 to 14	3.25 to 4.35	6 to 8
Found	2.64	9.02	2.69	11.71	3 31	6.12
Claimed	2 to 4			14 to 18		
Found	2.18	6.73	8.42	15.15		
Claimed	6 to 7.30	6 to 8	1 to 2		6 to 7	
Found	6.29	7.01	.72	7.73	5.51	10.18
Claimed	1.50 to 3	10 to 12	1 to 2		1.60 to 2.6	
Found	1.80	11.00	1.18	12.18	1.66	3.07
Claimed	1 to	7 to 9	1 to 2		2.7 to 3.7	
Found	1.19	7.19	.92	8.11	3.07	5.67

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Crocker Chemical Co., Buffalo	Ammoniated Wheat & Corn Producer	Manufacturer
Crocker Chemical Co., Buffalo	General Crop Phosphate	Wm. Weisenger, Deerfield
Crocker Chemical Co., Buffalo	No. 2 Superphosphate	Manufacturer
Darling & Co., Chicago	Chicago Brand	Manufacturer
Darling & Co., Chicago	Pure Ground Bone	Manufacturer
Darling & Co., Chicago	Vegetable Grower	Manufacturer
Darling & Co., Chicago	Farmers' Favorite	Manufacturer
Darling & Co., Chicago	Sure Winner	Manufacturer
Detroit Sanitary Works, Detroit	Clover Leaf	Manufacturer
Detroit Sanitary Works, Detroit	Superior Potato	Antony Beste, Detroit
Iron Cliffs Co., Negaunee	Bone Meal	Manufacturer
Michigan Carbon Works, Detroit	Homestead, a Bone Black	C. B Waterloo, Port Huron
Michigan Carbon Works, Detroit	Jarvis Drill Phosphate	C. B. Waterloo, Port Huron
Michigan Carbon Works, Detroit	Dessicated Bone	Manufacturer
Michigan Carbon Works, Detroit	Perfection Fruit Grower	Manufacturer
Michigan Carbon Works, Detroit	Homestead Vegetable Grower	Manufacturer
Michigan Carbon Works, Detroit	Homestead Potato Grower	Manufacturer
Michigan Carbon Works, Detroit	Homestead Lawn Fertilizer	A. J. Brown Seed Co., Grand Rapids

for 1897, expressed in parts in a hundred.

	Available nitrogen.	Phosphoric acid.			Potash soluble in water.	
	Estimated as ammonia.	Available P_2O_5.	Insoluble P_2O_5.	Total P_2O_5.	Estimated as K_2O.	Estimated as K_2SO_4.
Claimed	2.50 to 3.65	10 to 12	1 to 2	----------	1.6 to 2.6	----------
Found	2.84	10.19	1.56	11.75	1.95	3.60
Claimed	1 to 2	7 to 9	1 to 2	----------	1.08 to 2.16	----------
Found	1.17	9.15	4.43	13.58	1.57	2.90
Claimed	----------	11 to 13	1 to 2	----------	1.55 to 2.5	----------
Found	----------	12.20	.51	12.71	1.42	2.62
Claimed	2.5 to 3.00	7 to 9	4 to 5	----------	1 to 2	----------
Found	4.25	13.86	.28	14.14	2.00	3.70
Claimed	3 to 4	7 to 11	15 to 19	----------	----------	----------
Found	4.03	15.11	10.26	25.37	----------	----------
Claimed	4 to 5	7 to 9	1 to 2	----------	7 to 9	----------
Found	4.93	9.93	.97	10.90	6.88	12.71
Claimed	3.4 to 4.5	8 to 9	5 to 5.5	----------	4 to 5	----------
Found	4.88	14.45	.43	14.88	5.55	10.26
Claimed	1.46 to 2.5	7 to 9	4 to 5	----------	3 to 4	----------
Found	3.57	10.69	3.00	13.69	4.74	8.76
Claimed	2.5 to 3.5	----------	----------	9 to 11	----------	4 to 6
Found	3.42	6.73	2.92	9.65	3.68	6.80
Claimed	4 to 5	----------	----------	7 to 9	----------	7 to 9
Found	3.76	6.09	2.25	8.34	4.08	7.54
Claimed	4.20	----------	----------	23	----------	----------
Found	4.93	----------	----------	22.26	----------	----------
Claimed	2.25 to 2.92	8 to 11	.5 to 1.5	----------	1.50 to 2	----------
Found	2.89	9.39	1.36	10.75	1.95	3.60
Claimed	1.22 to 2.00	8 to 9	----------	----------	.75 to 1.25	----------
Found	1.65	8.93	.61	9.54	1.15	2.13
Claimed	1.50 to 2.43	----------	----------	25 to 30	----------	----------
Found	1.84	15.98	14.25	30.23	----------	----------
Claimed	1 to 1.50	10 to 11	1 to 2	----------	7 to 8.50	----------
Found	1.17	12.61	1.97	14.58	7.78	14.38
Claimed	5.6 to 6.5	5 to 6.5	----------	----------	6.5 to 7.5	----------
Found	6.12	6.43	.82	7.25	6.52	12.05
Claimed	2.35 to 3.25	8.5 to 10	.50 to 1.5	----------	5 to 6	----------
Found	2.72	7.73	1.95	9.68	6.37	11.77
Claimed	2.75 to 3.25	11 to 13	----------	----------	2 to 2.5	----------
Found	Anitrate 2.47	13.57	2.94	16.51	2.01	3.71

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Michigan Carbon Works, Detroit	Homestead Lawn Fertilizer	Manufacturer
Niagara Fertilizer Works, Buffalo	Queen City	Manufacturer
Niagara Fertilizer Works, Buffalo	Grain and Grass Grower	Stone Bros., Washington
Niagara Fertilizer Works, Buffalo	Wheat and Corn Producer	Stone Bros., Washington
Niagara Fertilizer Works, Buffalo	Triumph	Manufacturer
Northwestern Fertilizing Co., Chicago	Potato Grower	Manufacturer
Northwestern Fertilizing Co., Chicago	Challenge Corn Grower	Manufacturer
Northwestern Fertilizing Co., Chicago	Pure Ground Bone	C. B. Waterloo, Port Huron
Northwestern Fertilizing Co., Chicago	Fine Raw Bone	C. B. Waterloo, Port Huron
Northwestern Fertilizing Co., Chicago	Garden City Superphosphate	C. C. Vandoren, Adrian
Northwestern Fertilizing Co., Chicago	Prairie Phosphate	Manufacturer
Northwestern Fertilizing Co., Chicago	Raw Bone and Superphosphate Mixture	C. C. Vandoren, Adrian
Northwestern Fertilizing Co., Chicago	Dissolved Bone Phosphate	Manufacturer
Speidel, Schwartz & Co., Gd. Haven	Celery Hustler	N. Robbins, Jr., Grand Haven
Walton Fertilizer Co., Warren, Ohio	Diamond Cereala Soluble Bone	Manufacturer
Walton Fertilizer Co., Warren, Ohio	Special Dissolved Bone Phosphate	Manufacturer
Jarecki Chemical Co., Sandusky, O.	Lake Erie Fish Guano	Manufacturer
Jarecki Chemical Co., Sandusky, O.	C. O. D. Phosphate	Manufacturer

for 1897, expressed in parts in a hundred.

	Available nitrogen.	Phosphoric acid.			Potash soluble in water.	
	Estimated as ammonia.	Available P_2O_5.	Insoluble P_2O_5.	Total P_2O_5.	Estimated as K_2O.	Estimated as K_2SO_4.
Claimed	2.75 to 3.25	11 to 13			2 to 2.5	
Found	Anitrate 2.84	15.02	.92	15.94	1.96	3.62
Claimed		11 to 13	2 to 4			
Found		12.62	.38	13.00		
Claimed	1 to 2	7 to 9	1 to 2		1.08 to 2.16	
Found	1.11	8.57	2.18	10.75	1.40	2.59
Claimed	1.5 to 2.73	8 to 10	1 to 2		2.16 to 3.25	
Found	1.79	7.29	2.53	9.82	2.29	4.23
Claimed	3 to 5	8 to 10	1 to 2		2.16 to 3.25	
Found	4.13	9.90	.8	10.70	2.57	4.75
Claimed	3 to 4	7 to 9				4 to 5
Found	3.55	9.48	.85	10.33	2.64	4.88
Claimed	2.5 to 3.5	8 to 9				1 to 2
Found	2.91	8.39	2.92	11.31	.97	1.79
Claimed	3 to 4			18 to 22		
Found	4.79	13.30	9.06	22.36		
Claimed	4 to 5			22 to 24		
Found	4.40	11.49	10.52	22.01		
Claimed	2.5 to 3	8 to 9	4 to 4.5		.54 to 1.08	
Found	3.49	7.55	4.79	12.34	1.24	2.29
Claimed	2 to 2.5	6 to 8	3 to 4			
Found	2.94	6.38	4.50	10.88		
Claimed	3 to 3.5	7 to 8				1 to 2
Found	4.57	9.24	8.42	17.66	.75	1.39
Claimed	1.5 to 2	11 to 13		12 to 15		
Found	1.53	12.21	.92	13.13		
Claimed	8.62 to 9.52	3.17	.69			1.27 to 2.35
Found	7.58	3.40	1.41	4.81	1.29	2.38
Claimed	.5 to 1	14 to 16	2 to 4			
Found	1.10	16.87	1.38	18.25		
Claimed		12 to 14	2 to 4			
Found		14.24	1.12	15.36		
Claimed	2 to 3	10 to 12	1 to 2		1 to 2	
Found	1.80	9.39	1.74	11.13	2.05	3.79
Claimed		14 to 15	1 to 2			
Found		13.32	.78	14.10		

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Cleveland Dryer Co., Cleveland, O.	Ohio Seed Maker with Potash.	E. W. Spencer, Petersburg
Cleveland Dryer Co., Cleveland, O.	Buckeye Superphosphate	E. W. Spencer, Petersburg
Cleveland Dryer Co., Cleveland, O.	XXX Phosphate	E. W. Spencer, Petersburg
Cleveland Dryer Co., Cleveland, O.	Ohio Seed Maker	E. W. Spencer, Petersburg

for 1897, expressed in parts in a hundred.

	Available nitrogen.	Phosphoric acid.			Potash soluble in water.	
	Estimated as ammonia.	Available $P_2 O_5$.	Insoluble $P_2 O_5$.	Total $P_2 O_5$.	Estimated as $K_2 O$.	Estimated as $K_2 SO_4$.
Claimed	1.5 to 2.5	10 to 12		15 to 17		4 to 6
Found	1.12	10.44	2.46	12.90	3.22	5.66
Claimed	3 to 4	9 to 10		11 to 12	1 to 2	
Found	2.75	9.19	3 87	13.06	2.15	3.98
Claimed		13 to 15		15 to 17		
Found		14.81	1.31	16.12		
Claimed	1.5 to 2.5	10 to 12		15 to 17		
Found	1.65	10.16	3.02	13.18		

ESTIMATION OF VALUES.

Severe criticism has been made of the effort to fix an estimate of money value of the leading materials that make up a mixed fertilizer, the value per pound of available nitrogen, phosphoric acid and potash. A word of explanation may not be out of place. It is manifestly impossible to fix prices upon these materials that would everywhere be just and proper, because they are not equally distributed and of uniform cost in all places.

The attempt has been made to fix a scale of prices in the eastern states by finding the price of leading materials—bones, mineral phosphates, ammonia and potash—in such markets as New York and Philadelphia, and from such data to determine the average cost of nitrogen, phosphoric acid and absolute potash they contain. In this way some approximate idea is formed of the commercial value of these materials. This, however, is not to be taken as expressing the *agricultural value*, or what cash profit the farmer will secure from their use.

As previously stated the three most valuable materials in commercial fertilizers are potash, phosphoric acid and available nitrogen. Each of these has a commercial value which may be stated in dollars and cents. Only these three substances are considered in the inspection of commercial fertilizers because the other materials are of too little value to be purchased at high prices. By placing before the farmer the composition as claimed by the manufacturer and the composition of the material as found in the market, we can find whether the goods are up to standard and can also form an estimate of the market value of the goods. If the analysis shows more of a given substance than is claimed, the goods are better than claimed; but if much less is found on anlysis than is claimed, then the goods are proportionately of less value to the farmer.

The market value of these materials varies somewhat from year to year.

The following values have been agreed upon as the wholesale value of these materials for the year 1897:

	Cents per pound.
Nitrogen in ammonia salts	$0 13.5
“ “ nitrates	14
Organic nitrogen in fine ground fish, meat, blood and in high grade mixed fertilizers	14
Organic nitrogen in cottonseed meal, linseed meal and in castor pomace	12
“ “ “ fine ground bone and tankage	13.5
“ “ “ medium ground bone and tankage	11
“ “ “ coarse ground bone and tankage	08
Phosphosic acid soluble in water	05.5
“ “ “ “ ammonium citrate	05
“ “ in fine bone and tankage	05
“ “ “ medium bone and tankage	04
“ “ “ coarse bone and tankage	02.5
“ “ “ fine ground fish, cottonseed meal, linseed meal, castor pomace and wood ashes	05
“ “ insoluble (in ammonium citrate) in mixed fertilizers	02
Potash as sulphate, free from chlorides	05
“ “ muriate	04.5

Since there are 20 times 100 pounds in a ton, if we multiply the value of one pound by 20 we find the value of one per cent of any material in a ton. We may thus construct a table for estimating the value of any materials found in the results of analysis. One per cent means 20 pounds in a ton, and if the material is worth 5 cents a pound, then each per cent equals $1.00 for a ton.

The prices here given would represent the wholesale price of the materials bought in eastern markets, such as New York or Baltimore. This does not include the freight from those points or the cost of mixing, sifting and sacking, which would amount to $3.00 to $5.00 a ton.

I must again remind the reader that this trade valuation is not the agricultural value, but it may afford a means of comparing the trade value of different brands of fertilizers.

This Bulletin is submitted to the farmers of our State in hope that it may aid them to a better understanding of a somewhat complicated subject, yet one of great importance.

Most of the analyses for this Bulletin have been made by Mr. Thorn Smith, B. S., Assistant in Experiment Station.

R. C. KEDZIE,
Chemist of Experiment Station.

Agricultural College, July 8, 1897.

BACTERIA AND THE DAIRY.

CHARLES E. MARSHALL.

Bulletin 146.—Bacteriological Department.

With such excellent treatises as Conn's bulletins and Russell's text-book on "Dairy Bacteriology," there may be little need of any further popular consideration. We wish, however, to give those farmers in the State of Michigan who have not been fortunate enough to come in contact with the above works, a brief and simple statement of the questions involved in dairy bacteriology at the present time and also an explanation of some of the perplexing phenomena connected with the handling of milk.

Although it is but recently that bacteriology has interfered in a practical way with dairymen, dairy bacteriology is as old as the science itself. Boutron and Fremy in 1841 worked blindly upon lactic acid fermentation, because bacteriology had not been born; yet to scan their experiments, one cannot help feeling that they were cognizant of an agent at work which they could not grasp. It is true we are inclined to attribute all the glory to the great comprehensive mind of Pasteur, and rightly so; but we must not forget how well the way was paved by previous diligent and faithful scientists. Spallanzani (1776), Schulze (1836) and Schwann (1839) had to precede Pasteur; without tem Pasteur would have found many obstacles in the way of his progress. No mind can apprehend the vast amount of good Pasteur did for France and through France for the whole world. Millions of dollars were invested in silk production, the ruin of which was threatened by the silk worm disease practically eradicated by Pasteur. His insight into the wine diseases also saved large sums of money to France. What he has done in the saving of life is beyond pecuniary valuation. It was he who instigated the movement in dairy bacteriology by his limited work on some phases of milk fermentation. Since his activity there has been a sprinkling of investigators in the matter of milk fermentation, but our comparatively recent workers as Storch, Weigmann, Duclaux, Adametz, Freudenreich, Conn and Russell represent the truly practical and beneficial results which now belong to dairy bacteriology.

When the modern scientific dairy methods are compared with the methods of ten and twenty years ago, the significance of bacteriology becomes apparent. Answers to the questions of the causes of various abnormal conditions have been given. The souring of milk and its putrefaction, the appearance of color, the presence of a bitter taste and ropiness have all been explained. Cream is now ripened by pure cultures, cheese is made in accordance with the laws of fungal and bacterial growths and the commercial requirements demand Pasteurized milk.

MILK AS A FOOD FOR BACTERIA.

The chemical composition of milk appears to the bacteriologist not by the number of components involved but rather by the value each component possesses as a food for bacteria. Considering the analysis of milk in this light and remembering what was said in Bulletin 139, p. 68, regarding the food requirements of bacteria, the component parts of milk may be resolved into three classes: the nitrogen class, the carbohydrate or sugar class and the fat class. The igorganic salts are essential but subsidiary to our purpose.

The first class is represented by casein, the parent substance of cheese. It is this which provides the bacteria with the necessary nitrogen for their development. Owing to the various actions bacteria have upon casein, it affords us a means of ascertaining how different species attack its molecule and thus aids us in determining species. In some cases there is a process instituted similar to putrefaction and again there is simply a digestion of the casein. With other species there is no change whatever in the casein. Whatever change is undergone by the action of bacteria, it furnishes them with nitrogenous food. Sugar of milk (lactose) is the main component of the second class. Containing carbon, hydrogen and oxygen, it offers three food elements to bacteria. The atoms of carbon, hydrogen and oxygen making up a molecule of sugar are sometimes torn asunder; lactic acid which usually produces the souring and curdling of milk, alcohol which is utilized in the manufacture of certain alcoholic milk drinks and carbon dioxide gas are the resulting fragments of the destroyed molecule of sugar.

In the third case but one element has been mentioned, the fat. Upon this substance bacteria have little effect, except indirectly. The bacteria do not seem to feed upon it or change it in any manner. The changes that appear to take place in cream and butter are usually traceable to other compounds than fat. So seldom is fat acted upon by bacteria that it is almost disregarded by bacteriologists.

In milk, nitrogenous food is in abundance, carbon, hydrogen, oxygen and inorganic salts are not lacking, consequently milk is an excellent food for bacteria.

MILK IN THE UDDER.

Milk in its *normal* condition in the udder is free from all forms of bacteria. This is an old belief that has been established repeatedly by numerous investigators in Europe and elsewhere. Some have ventured to question this accepted belief; yet, from the present standpoint, bacteriologists in general adhere to the old work.

There are, however, two methods by which milk may be contaminated even in the secure gland, the udder: the one, when a cow is affected with some bacterial disease; the other when bacteria find their way through the milk duct of the teat into the milk sac at the base of the teat and thus into the ducts which lead into the sac from the glandular substance of the udder.

In the discussion of the first method we are urged to consider tuberculosis, by its importance and the interest centered upon it at present. In this dreaded disease, which causes the death of every eighth person, the *bacillus* of tuberculosis may find its way into the milk if present in the cow. This is more likely to take place if the disease is located in the udder. In this case, tubercles formed by some process of irritation of the *bacillus*, multiply in the tissue making the udder. At first they are generally little hard nodules; but these keep enlarging and eventually become soft, caseous and even purulent; a semi-fluid pus is found in them. If one of these tubercles should be located along any one of the numerous milk ducts leading to the milk sac, and it should grow, finally breaking down into a purulent substance, the contents of this tubercle with the thousands of *tubercle bacilli* it contained would rush down the milk duct into the milk sac and would thus contaminate the milk. We have supposed that the disease was seated in the udder; is it possible if the disease is confined to the lungs or other organs? We are permitted to answer only in the affirmative, inasmuch as the *bacilli* have been found present in the milk when no local lesions of tuberculosis could be discovered in the udder. Just how they, the bacilli, reach the udder involves too many suppositions and complications to even suggest in this place. When it is ascertained how they make their journey from a tuberculous lung to the milk gland, it will be time to discuss it, and it will then be simple to understand. That the *bacilli* of tuberculosis may reach the milk in the udder of a cow no matter where the disease is located in that cow is indisputable, having been established by competent workers. The per cent of tuberculous cows giving tuberculous milk varies from a very low figure to a very high or startling figure, consequently, the *milk of tuberculous animals is dangerous.*

The other method of contaminating the milk in the udder is through the milk duct of the teat. Although apparently closed to all foreign substances, it nevertheless fosters hosts of bacteria. For some time past, bacteriologists have been reporting the number of bacteria found in the "fore" milk, "middle" milk and strippings. Invariably they find the most to abound in the "fore" milk. The first milk drawn from a cow washes out the ducts and leaves few bacteria to infect the "middle" milk and strippings. In another way the duct may be demonstrated to be burdened with bacteria. Disinfect the udder and teats with as much care as possible, introduce a sterile milk tube connected with a sterile flask closed with cotton wool into the milk duct, and the milk after standing in these flasks for some time will show the presence of bacteria. Out of twenty-eight samples obtained in this way the author obtained only two which were sterile. In a very few of these samples, several weeks were required to show any change whatever.

On the other hand, where the precaution was observed to remove some milk before the insertion of the milk-tube, a larger portion of the samples was sterile. In working with contagious mammitis, the author has obtained pure cultures of Nocard's streptococcus by following the method above. This method is described in Bulletin 140, page 101.

CONTAMINATION OF MILK AFTER LEAVING THE UDDER.

It is not my intention to give practical methods to be observed in the perfection of cleanliness about the cow, barn and dairy. My province is confined to the habits of bacteria and their relation to milk. To avoid their access to milk, I shall simply offer general suggestions. Some of these may seem anticipatory and impracticable, still we live in an age of progress and changes, and hope to see feasible methods realized some day. It must not be expected that the dairyman and bacteriologist will accord in these matters; both will, however, work in unison to a satisfactory solution of the problems in hand.

As soon as the milk has escaped the duct of the teat, the chances of contamination have multiplied greatly. The avenues of access have increased and may be considered under: exposure to the air of barn and dairy; exposure to the filth from the cow; exposure to the particles of dirt from the milker; exposure to the milking and dairy utensils.

Exposure to Air of Barn and Dairy.—The number of bacteria varies with the locality and circumstances. The air over a meadow is comparatively free from bacteria; in the city air the number has multiplied a thousandfold, and if we pass on to the air of a cow stable, the number has increased several thousand fold over that of the city. Unless each individual is willing to make an experiment for himself, he will appreciate in a small degree the contaminating power of the cow stable air. This knowledge may be gained in a crude way by exposing a smooth surface, as glass, to the air of a stable for a few minutes, and while the exposure is being made watch the small, almost imperceptible particles of dust falling upon it. Each particle represents by no means a single microbe, but scores of them which adhere to the surface. As each particle becomes dissolved in milk those germs which are hidden within its interior are liberated for activity.

Currents of air serve to facilitate the travel of these micro-organisms. Bits of decomposing matter, pieces of straw from the manure heap, and the pulverized dirt and dung of the stable and barnyard are picked up and borne along, and part of them will find their way into the milk.

Any disturbance of dust must be avoided. The handling of hay at the time of milking or before only adds many fold to the germ content of the air. The stirring of the bedding is obnoxious. The hay and straw are loaded down with bacteria awaiting only a suitable food in which to grow.

In a well kept dairy the air bacteria are not numerous. The dairy I now have in mind has a cement floor and a good drain; with these two agencies it is possible to keep down the dust. Where there is a board floor, unless it is kept exceptionally clean, there is always a stream of dust, visible or invisible, rising when passing over it. In such instances there must be many bacteria in the air which eventually fall into the milk.

Exposure to the Filth from the Cow.—There is nothing more filthy than the filth from the cow. There is nothing that is so effectual in rendering milk unwholesome. There is no part of the handling of milk that needs revolutionizing and renovating more than the process of milking. After studying this feature for an extended time the student loses his hunger for milk. We accept the conditions as they are simply because we are accustomed to them and they have come to us as an inheritance.

The American method of milking is simple. The milker sits down to the cow, with the milk pail on his knee exposed to much of the filth he brushes from the udder, teats and lower portion of the cow with one sweeping motion over the entire region. Upon these parts of the cow will be found lumps of dung, pieces of straw, loose hairs, epidermis scales and dirt from various sources. If a clean glass plate is exposed underneath the cow, the amount of filth that will collect is surprising. In this filth can be discerned particles of straw, dung, dirt, loose hair and epidermis scales. The bacteriologist is unable to make a correct estimation of the number of bacteria contained, although numerous estimations have been made. Conditions vary and it is impossible to bring every bacterium in contact with the food medium in which only a part will grow. Again there may be no complete dissolution of the particles loaded interiorly with bacteria, for milk drinkers very frequently meet with undissolved particles of dirt at the bottom of their glasses. Millions have been counted and probably many more millions fall into the milk during the process of milking.

Exposure to Particles of Dirt from the Milker.—A milker may add much to milk contamination by means of dirty hands and clothes. Although we cannot say that this source furnishes as much filth as the two preceding, yet there is a possibility of danger from this source which the other two sources are not likely to possess. This danger is that which arises from the contagion of contagious or infectious diseases. A milker may carry upon his clothes the bacilli of diphtheria, of typhoid fever and other obnoxious diseases. A tuberculous subject should never milk when the milk is to be consumed by others. In some unseen way the baccilli of tuberculosis find their way into the milk and thus menace the health of those who drink the milk. It is thought that scarlet fever has been communicated through milk probably by means of the milker. Some of the most contagious diseases have failed of recognition because we have not yet identified the micro-organisms concerned, and therefore are unable to trace them definitely.

Exposure to the Milking and Dairy Utensils.—This means of contamination is under the absolute control of the dairymen, for it lies within his power to rid his utensils of all bacteria. However, it is not usually the case that the milk pail is bacteria free. How frequently it happens that a dairy utensil after it has been cleaned according to the common methods has a greasy film over its surface which may be easily detected with the finger. The crevices are filled with dirt which may be scraped off with the point of a pen knife. Upon studying the dirt adherent to the milk pail, it has been discovered that it is almost a mass of bacteria. This was found after the pails were treated with brush and steam but not with sufficient care. A *little* brushing, a *little* hot water and a *little* steam are *little* effective; what is needed is hard brushing until all the dirt is removed, and the addition of plenty of *hot* water (212° F.) for several minutes, and if steam, let it run for a few minutes. This is necessary if the life in the pail is destroyed. Too much care cannot be exercised in this direction.

Since milk in the udder is free from bacteria and the only likely contaminations are through the sources named above, the importance of cleanliness is manifest.

VARIETIES OF BACTERIA IN MILK.

It would be unsafe to place any definite limit to the number of species found in milk since it harbors bacteria which may come from almost any source. The conclusion is forced that the number of species is unlimited.

Those bacteria which find their home in the filth of the barnyard, the dust of the barn or dairy, in the soil and water, are the species usually found in milk. To consider the possibilities of their actions is beyond our present scope. Suffice it to say that the bacteria usually finding a residence in milk belong to the saprophytic and non-pathogenic class.

There is a class of bacteria which, having once established themselves in a dairy, become a part of it and exert their influence daily. These are the lactic acid bacteria, and they are constant factors in the ordinary milk changes.

MULTIPLICATION OF BACTERIA.

The bacteria having gained access to the milk and finding a suitable temperature soon begin to multiply. How rapidly they may increase has been considered in Bulletin 139, p. 67. If we start with several millions and increase in a geometrical ratio using every thirty minutes as the unit of time, the enormity of the number after a few hours growth is scarcely imaginable. Frequently after the milk has stood several hours it is possible to find hundreds of thousands in a single drop. Too rapid souring of the milk is not desirable, and if obnoxious bacteria grow in this way and gain the ascendency over the lactic acid bacteria, bad and even harmful results are obtained.

To secure the best milk products, it should be the plan of every dairyman to delay unnecessary fermentation by whatever legitimate method is at his command. Perhaps the most economical and inexpensive is the cold water method of reducing the temperature below that required for the growth of bacteria.

INFLUENCE OF TEMPERATURE UPON BACTERIA IN THE DAIRY.

Cold prevents growth, heat checks growth or kills the bacteria. Out of fifteen lactic acid producing bacteria, isolated by Kayser (Cent. f. Bact. II. Bd. I. p. 436) none formed lactic acid at 10° C., even when allowed to act for thirty-five days. Five would not produce curdling at 15° C. This shows that a low temperature is able to keep milk from souring for a long period. It must not, however, be understood that cold kills the bacteria or renders them inactive when they are transferred to a warm temperature. On the other hand, it simply retards their growth while they are under the influence of the cold only, for when they are transferred to a warm temperature they grow as readily as those bacteria which have been kept at a warm temperature for some time.

When we take milk from the cow and put it immediately into a cooling vat, we simply keep the bacteria from multiplying. They remain dormant, as it were, as long as the milk remains cold. But if the milk is placed in a warm atmosphere, they will multiply as rapidly as though they had never been chilled. To be successful, therefore, in handling milk in the cold, it is necessary to cool it as soon as possible after milking and to keep it cool until consumed.

The heating of bacteria either checks their growth or kills them. There is a great difference among the various species in regard to this. While some are killed at 60° C., others seem to be uninfluenced and still others merely have their growth checked. This is true at the different temperatures ranging from 60° C. to 100° C. There is quite a number of bacteria which will withstand a heating of 96° C. for twenty minutes and will continue to grow as though they had not been subjected to any enervating influence. The large class of lactic acid bacteria is mostly destroyed at a temperature of 65° C. but there are a great many, usually those containing spores, remaining that will cause various actions upon milk. As a rule, they first curdle the milk, then peptonize it.

It is not possible to heat milk indefinitely, without altering it chemically, therefore destroying its palatability. In heating milk above 75° C. there is always produced a cooked taste. Consequently we are limited in the application of heat as a means to exterminate bacteria.

PASTEURIZATION AND STERILIZATION.

This is simply the application of heat as the means to exterminate some or all of the bacteria present in milk. Pasteurization consists in heating the milk at 70° C. for twenty minutes (the temperature and time are both variable). Pasteurization has been resorted to in order to obviate the cooked taste in milk, to enhance its keeping qualities, to kill disease-producing germs and to reduce the number of ordinary milk bacteria. Its intrinsic value lies mainly in its destruction of disease-producing germs. Concerning a further discussion of this matter, I take pleasure in referring you to Bulletin 133, and the bulletin that follows.

Complete sterilization is impracticable in the commercial handling of milk. It produces a cooked taste in the milk rendering it unpalatable. It changes the composition of milk, to a certain extent. There is no demand for it. There are, however, purposes for which sterilization is absolutely necessary, but for a commercial product, little can be said in its favor. It is true that in sterilizing milk, we kill all the bacteria present, yet this is no argument, inasmuch as ordinary milk bacteria produce no direful effects in the animal economy.

MILK FERMENTATIONS.

Through fermentations in milk, bacteria manifest their presence. It would make no especial difference how many bacteria entered the milk if they simply developed, and consumed a portion of the milk, produced no diseased conditions nor altered the composition of the milk. But when we consider that all of the usual changes in milk are due to the actions of these bacteria, their rôle at once begins to assume an important part in dairy economy.

Our acquaintance with the usual fermentations about us, such as the changing of cider into vinegar, grape juice into wine and the like, helps us to conceive of milk fermentations. In order that we may arrive at a systematic understanding of this question, it will be necessary to divide the subject into several heads:

Bacteria producing pigment;
" " alcohol;
" " lactic acid;
" " butyric acid;
" " rennet ferment;
" " slimy milk;
" " bitter milk;
" " soapy milk;
" " poisonous milk.

Although some of these functions cannot with propriety be assigned to fermentation, still these bacterial functions can with profit be considered coördinately.

PIGMENT FORMATION.

There is reason why this is not more commonly observed. Inasmuch as many bacteria which produce pigment will not grow and give rise to pigment in an acid medium, any pigment-bearing bacteria are likely to be passed over unnoticed; still anyone familiar with the bacteria of milk will tell you that a failure to isolate pigment from any ordinary sample of milk is a rare occurrence. They are common in milk and either do not succeed in developing along with the many other species present or the acidity destroys the pigment. Although this is usually the case, there are many plagues of colored milk occurring in dairies.

A common color in milk is red. This may be due to a variety of bacteria. A yeast plant has also been found by the author in many samples of milk originating from the same source. The color produced by these pigment producing micro-organisms may be simply a scum over the surface or may be uniformly distributed throughout the milk.

There are many yellow pigment bacteria found in milk. All shades will be noticed, from an orange yellow to a lemon yellow. These bacteria may find their way into the milk from the air, dairy or cow, since they are widely distributed. Most of the yellow pigmented bacteria produce a peptonizing ferment which is not advantageous to the quality of cream or milk.

A greenish color is also quite frequently present. It usually originates from flourescing bacteria which have fallen in generally from the cow. In their action upon milk they produce a very unpleasant odor which seems to be characteristic of this class.

Perhaps the most common pigmented disease of milk is what the Germans call "blau milch." It is uniquely common in the northern part of

Germany and in certain districts of Europe, but in this country the cases are not so common. This trouble is due to a bacillus which grows very rapidly in milk. With the formation of acid or the regular souring of milk it gives a sky blue color; but if the milk remains sweet, it yields a slaty appearance. The source of this bacillus is probably the filth which contaminates the milk; yet its sudden appearance at times would lead to other deductions. The germ is harmless in itself and yields no strongly poisonous products. It has also been found in cheese and in such a case yielding blue cheese. The most certain way of eradicating it is by careful disinfection and cleaning.

ALCOHOLIC FERMENTATION.

It is a common characteristic of many bacteria as well as yeasts to produce alcohol. This substance is widely distributed in various fermentations either as a resulting primary product, as in beer and wine fermentations, or as a secondary product, in reality a by-product, in intestinal fermentation. Many of the bacteria permanently resident in the intestines will yield sufficient alcohol—during their process of development in certain food preparations—to give a decided chemical reaction. The alcohol usually is the result of the destruction of some carbohydrate—that is sugars, starches and like substances.

Milk sugar (lactose) may be converted into alcohol under favorable conditions. The presence of the proper ferment is only required in connection with a suitable temperature to change milk sugar into alcohol. Although this fermentation has little practical significance for the dairyman, there are sections in which the alcoholic fermentation of milk is of considerable value, inasmuch as the alcoholic milk is used as a drink by the inhabitants.

Koumys, milk wine or lac fermentatum, originally prepared from mare's milk, but now from cow's milk as well, to which some sugar has been added, has been used for hundreds of years in Asia and the name is taken from the tribe which first employed it. Many sanitarians recommend it because they regard it as more easily digested than the milk as it comes from the udder. While alcohol is the chief product of fermentation, it must not be forgotten that lactic acid and acetic acid enter into its composition. In wine fermentation there are several minor products as fusel-oil, acetic acid, glycerin and others, so here we have analogous secondary or by-products, and these by-products lend flavor to the taste.

Kephir is a preparation made by the people of Caucasus and is made from the milk of cows and sometimes of other animals. There seems to be present in kephir fermentation three distinct fermentative agents: the lactic acid ferment which produces a certain amount of lactic acid equal usually to that of the alcohol; the yeast or alcoholic ferment which makes the preparation an alcoholic drink; [Hammersten is made to say by Fleischmann that out of 100,000 parts of kephir 727 parts are lactic acid and 720 parts are alcohol,] and the peptonizing ferment which renders some of the casein soluble. Although the lactic acid and alcohol come from the milk sugar, a good portion of the latter is left.

The preparation is effected through the instrumentality of kephir-grains which are yellow, hard, and about the size of a pea. These grains are apparently zoöglea of bacteria and yeast plants [See Zoöglea Bul. 139.] used as we employ yeast.

LACTIC ACID FERMENTATION.

This is the fermentation with which we have so commonly to deal; it is the ordinary souring of milk. Before the days of bacteriology, it was supposed to be due to a chemical change instituted by the oxygen of the air; it was also recognized that the nitrogenous components of the milk had an important bearing in the development of lactic acid in the milk. Pasteur in his biological explanations of fermentation was able to demonstrate that lactic acid fermentation or the ordinary souring of milk was due to micro-organisms. Lister was the first to isolate a single species which had this special function. Hueppe has given us several species which are well known as Hueppe's lactic acid bacteria. Many lactic acid micro-organisms have been described since Hueppe's, all having certain characteristics in common but differing in some morphological or cultural features.

Each dairy has its lactic acid bacteria and it would be found that while belonging to the lactic acid group of micro-organisms, they would represent perhaps several species. These lactic acid bacteria become the property of every dairy; once located they grow and increase with the dairy, inhabiting every cranny, dairy utensil and barn; the entire milking outfit is their home and they are fed at each milking and at the same time multiply rapidly.

The souring of milk is the conversion of milk sugar into lactic acid by the action of micro-organisms. In this change small quantities of carbonic acid gas and alcohol are likely to be evolved also; however these are lost sight of in the formation of the acid. The casein of the milk is cast down by the acid formed and thus gives the curdled appearance of soured milk. After a small per cent of acid is formed, the lactic acid bacteria cease to grow; hence it is that the acidity never reaches a very large per cent, from .5 to .8 per cent.

The temperature at which this fermentation takes place lies between 18⅓° C. [65° F.] and 35° C. [95° F.] but is perhaps conducted best between 23° C. [75° F.] and 30° C. [85° F.]. The bacteria which produce the fermentation grow very slowly below 15° C. [60° F.] and are readily killed at 68° C. [155° F.]. Bearing in mind the relation of temperature to the growth of the lactic acid bacteria, the regulation of this fermentation may be carried out at will. The questions: "Why does milk sour more quickly in hot weather?" or " Why does it sour so suddenly before a thunderstorm?" find their answers in the consideration of temperature.

In the process of Pasteurization, the lactic acid bacteria are usually killed; accordingly, those bacteria which remain in the milk after Pasteurization are those bacteria which precipitate the casein or curdle the milk not by the formation of any acid but by the secretion of a ferment; consequently, curdled Pasteurized milk has little acidity.

A lactic acid fermentation product which has been used by the Armenians as a drink and the ferment of which they have employed in the making of butter is called "matzoon." Its taste is that of a rich buttermilk and its appearance resembles a very fine granular and frothy curd. It is manufactured in this country by Dr. Dadirrian of New York, and is highly recommended by professional people. The analysis given and compared with kumyss is as follows:

	Matzoon.	Kumyss.
* Water	87.69	90.99
Proteids	3.98	2.04
Fat	4.01	1.91
Milk sugar	2.03	3.26
Alcohol	.07	.62
Ash or mineral salts	.78	.44
Carbon dioxide	.04	.44
Lactic acid	.50	.00
Acetic acid	.00	.30

Matzoon is certainly very palatable and I understand that it is used almost exclusively in Armenia. The milk as it comes from the cows is scarcely ever used, but in place of it matzoon is commonly employed.

In its prepartion, the milk is Pasteurized at a high temperature and some matzoon is added to it as a ferment. The milk is then placed away until fermentation takes place. The longer it stands the sourer it becomes. It is therefore used when fresh or is kept in a cold place to allay fermentation.

Dr. Dadirrian, of New York, and Mr. Caramanian, of this College, have kindly furnished me with samples of matzoon and the desired information.

BUTYRIC ACID FERMENTATION.

The importance of butyric acid fermentation is not so great to the dairyman as the one preceding (lactic acid fermentation), but it has its significance in the various changes which occur in milk, butter, and cheese. Its presence may be detected by the rancid butter odor. Usually in milk treated by the ordinary methods, this fermentation seldom obtains a perceptible start. In butter exposed to favored conditions for decomposition assisted by certain micro-organisms, it is of very common occurrence, and is recognized by the butter's rancidity. A distinct butyric acid fermentation is often noticed in cheese.

As in lactic acid fermentation so in butyric acid fermentation, Pasteur was the first to demonstrate its relation to micro-organisms. It was he who was first able to combine certain chemical compounds in a solution and by the introduction of an almost pure culture of a single species of bacteria establish the fact that a certain component of this solution, a lactate, a form of lactic acid, was changed into a butyrate, a form of butyric acid. Although Pasteur did not work with an absolutely pure culture of a single species of bacteria, his culture was nevertheless sufficiently pure to prove the action of this single species. In this connection, it is interesting to note that the micro-organisms with which he was dealing, was one that would not grow in the presence of the free oxygen of the air; in short, it was an anaërobic bacillus, the first that was ever considered. It is also interesting to note that many of the anaërobic bacteria are in some way associated with the formation of

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* Prof. Wm. H. Porter, M. D., Merck's Bulletin, Vol. VI., Nos. 1 and 2.

butyric acid. Besides Pasteur, Conn, Fitz, Prazmowsky, Hueppe and others have added much to the study of butyric acid fermentation.

Attention has already been called to its presence in milk, butter and cheese, but its presence elsewhere in nature must not be overlooked. In the intestinal tract there is a certain amount of butyric acid produced by the action of bacteria and in some cases in such large amounts as to render the functions of the lining membrane abnormal and thus produce one form of dyspepsia. Again it is found in some of our food fermentations, as sauerkraut.

This fermentation may result from the transformation of grape-sugar, starch, lactic acid and albuminous substances. In milk, it is generally considered to be the change of lactic acid and by others to sometimes occur directly from milk sugar. As by-products, carbon dioxide and free hydrogen are eliminated. Inasmuch as this fermentation takes place in the presence of the nitrogenous constituents of the milk, such as casein, there are other products manufactured by a secondary fermentation of these micro-organisms which tend to neutralize any acidity present and dissolve or throw in solution the casein. This secondary fermentation may belong to the butyric acid micro-organisms or may be the result of the activity of other micro-organisms. However this may be, ammonia and ammonia compounds and derivatives of ammonia are frequently found present.

PEPTONIZING FERMENTATION.

Intimately associated with the rennet ferment is the peptonizing property of some bacteria. These bacteria are usually those that have the power to produce the precipitation of casein, but the peptonizing action follows that of the rennet action; yet this is not always true, for there are those bacteria which are able to peptonize without the production of any rennet ferment, although they are comparatively few in number. It would seem that these bacteria acted somewhat differently in the peptonization of casein, because there are those cases where we have the solution so perfect or the casein so completely peptonized that the milk has become as clear as water; there are those, also, which are able to peptonize the casein only in part, so that the casein remaining settles to the bottom, usually in a gelatinous mass with a watery layer above; and again there are those which peptonize the casein only in part and leave it in a semi-clear condition.

The change of the casein is similar to the change of meat in the process of digestion. Our meat is changed into a soluble form before it is assimilated by the organs of assimilation. In the case of casein by the action of this peptonizing ferment, a soluble product is obtained which is closely allied to the soluble product obtained from meat by the process of digestion. This product from meat is known as peptone and from casein as caseon.

RENNET FERMENTATION.

Imagine a series of vessels of equal size all having the same amount of milk in them, before you, and in each a single species which possesses the rennet action. You would be able to discern that there is a great variety of appearances in the precipitated casein. There would be all shades, from the truly loppered milk to the finely granular particles of casein often produced by the action of bacteria. While we are able to affirm that these conditions exist and are able to see them and note the differences, yet we are unable by the use of language, to describe these differences.

A rennet action consists in the precipitation of casein and may occur under acid or alkaline conditions of milk. In the formation of lactic acid the casein is precipitated by the direct action of the acid upon the casein; but when we have a neutral or alkaline solution, the action is different, it is the result of a ferment produced by bacteria. This ferment is capable of separation; it, when isolated, may be introduced into milk and produce the precipitation of the casein.

In a large number of species of bacteria obtained from Pasteurized milk, it is markedly noticeable that most of them will precipitate the casein of milk without the formation of any acid.

BITTER MILK.

It is not an unusual occurrence upon tasting a bowl of milk to find that it is bitter. This bitterness is due to bacteria which gain access to the milk and then give rise to products of a bitter taste. Hueppe was of the opinion that this bitterness was due to the formation of peptones by the peptonizing bacteria and we are not at all certain that this action is not in certain cases accompanied by bitterness, although in many cases it seems the result of special products.

Dairies and factories have been visited by these bitter milk bacteria with great loss. Weigmann has also demonstrated their presence in cheese. Wherever they are found in milk or its products the total destruction of the material usually follows.

ROPY OR SLIMY MILK.

The subject of ropy milk has been discussed in Bulletin 140, in which was described a bacillus that was found to produce ropy cream. It will not be out of place, however, to mention in this connection a few of the most important features of ropy milk and cream. The number of bacteria producing this condition of milk and cream is exceedingly large and if more attention were given to the morphological and cultural study of these bacteria, this number could probably be reduced considerably, because it would probably be found that several of these now distinct species would be proved identical. The one cited in Bulletin 140 has many characteristics common with several of the species concerned in the production of ropy milk; yet owing to the scarcity of detailed data, it was impossible to identify it at the time of writing the bulletin. We will not stop, however, to consider the various bacteria as species associated with this condition of milk and cream, but will only state that they vary greatly in their methods.

One species will produce ropy milk through the adherence of one bacterium to another by means of an adhesive cell wall, and this ropiness will not only manifest itself in milk but also in other media in which it may be grown. Another species will produce ropy or stringy milk by changing the milk sugar into a viscous form and again we will have other species acting upon the albuminous substances, it may be the casein of the milk, changing them into a slimy mass.

If we should isolate several species which are commonly present in milk and allow them to grow for a long period in milk, unassociated with any other species, we would find after several weeks that there would be some producing a condition of the milk which would be slimy and even ropy in many cases. From this we would conclude that ordinarily there are found in milk, bacteria which would give rise to either ropy or slimy milk, provided all the conditions were favorable to their development.

It is fortunate, however, that there are desirable germs which gain the ascendency over these undesirable germs, therefore they are usually unable to manifest their presence. Whenever we find species which grow more rapidly than the lactic acid bacteria, we are then made aware of their presence by their actions upon the milk and only then do we meet with ropy or slimy milk.

SOAPY MILK.

A peculiar condition of milk is that of soapiness. Upon handling it, it responds much like soft soap. An instance of this kind was reported by a dairyman in Illinois, who said that if his whey tanks were not scalded, his whey would appear like soft soap upon dipping. Several other occurrences of this nature are recorded in literature, but it is necessary to say only that these circumstances are brought about by specific micro-organisms which have a tendency in their action upon milk to convert it into a soapy condition. In my work in the laboratory, I have found bacteria isolated from milk which would produce the above condition. These bacteria seem to act upon the casein and albumin.

POISONOUS MILK.

We have satisfied ourselves thus far that bacteria are able to act upon milk in diverse ways. Some of their actions we regard as beneficial, while others as sorely detrimental. In the consideration of the production of poisons by bacteria, we must bear constantly in mind that although this phase of bacterial action stands out very prominently and has a peculiar interest, it is simply coördinate with the other manifestations of bacteria in milk. Instead of having lactic acid or butyric acid as the product of bacteria, we have an intense poison, hardly comparable with poisons known to us. Vaughan, of the University of Michgan, has the credit of being the first to isolate a poison called tyrotoxicon, which is perhaps the most common of bacterial poisons in milk. It was originally found in cheese, from which it took its name, but it has been repeatedly found in milk, ice cream and cheese. In "Ptomains and Leucomains," the authors, Vaughan and Novy, have cited several cases of milk poisoning. In one case, "on August 7, twenty-four persons, at one of the hotels at Long Branch, were taken ill soon after supper. At another hotel, on the same evening, nineteen persons were seized with the same form of sickness. From one to four hours elapsed between the meal and the first symptoms." * * * While the cause of the sickness was being sought for, and one week after the first series of cases, thirty persons at another hotel were taken ill with precisely the same symptoms as noticed in the first outbreak. " * * * Further inquiry revealed the fact that all who had been taken ill had used milk in greater or less quantities, and that persons who had not partaken of milk escaped entirely; corroborative of this, it was ascertained that those who had used milk to the exclusion of all other food were violently ill. This was prominently noticed in the cases of infants fed from the bottle, when nothing but uncooked milk was used. In one case an adult drank about a quart of the milk, and was almost immediately seized with violent vomiting, followed by diarrhœa, and this by collapse. Suffice it to say, that we were able to eliminate all other articles of food and to decide that the milk was the sole cause of the outbreak."

"Having been able to determine this, the next step was to discover why that article should, in these cases, cause so serious a form of sickness."

"* * * * * * It was soon ascertained that one dealer had supplied all the milk used at the three hotels where the cases of sickness had occurred. His name and address having been obtained, the next step in the investigation was to inspect all the farms, and the cattle thereon, from which the milk was taken. We also learned that two deliveries at the hotels were made daily, one in the morning and one in the evening; that the milk supplied at night was the sole cause of the sickness, and that the milk from but one of the farms was at fault."

"The cows on this farm were found to be in good health, and, besides being at pasture, were well fed with bran, middlings and corn-meal."

"* * * * * * * The cows were milked at the unusual and abnormal hours of midnight and noon, and the noon's milking—that which alone was followed by illness—was placed, while hot, in the cans, and then, without any attempt at cooling, carted eight miles during the warmest part of the day in a very hot month. * * * * * *"

"The results of our inquiry having revealed so much, we next attempted to isolate some substance from the poisonous milk, in order that the proof might be more evident."

"* * * * * * We are justified in assuming, after weighing well all the facts ascertained [*I have purposely omitted the chemical examination. Author.*] in the investigation, that the sickness at Long Branch was caused by poisonous milk, and that the toxic material was tyrotoxicon."

Associated with these cases of poisonous milk, we invariably find undesirable methods or circumstances for the handling of milk. Either filth has furnished these toxicogenic bacteria or they have got in from what might be called natural sources and have developed under conditions to which no milk should be subjected.

BACTERIA IN BUTTERMAKING.

Sweet cream makes an insipid butter, unmarketable and undesirable. We have always been accustomed to butter made from soured cream, and unless we have an evolution in taste, butter made from soured cream will always be in demand. We know from our discussions so far that there is always a possibility of having bacteria present which will induce within the cream abnormal changes. It is therefore a matter of importance to secure if possible only those bacteria which will produce the desired change in the cream. In seeking these bacteria, it should be the aim to select those varieties which will give rise to that peculiar acid flavor coming from soured cream, as well as the nutty flavor arising from the aroma and to yield a butter of good keeping qualities. Having once gained such a species of bacteria, we shall then be able to obtain a uniform product. As to the acid flavor in butter, there is some question. Dr. Conn makes the claim that acid-producing bacteria are not essential in the production of rich flavored butter. His experience with bacteria in the ripening of cream commands consideration, but there are those who positively affirm that acid-producing bacteria are absolutely essential to a highly flavored butter. Inference would lead us to suppose that one's taste is accustomed to the acid flavor, and of course, would demand it. On the other hand, there is no doubt that the non-acid variety of bacteria will give delicate shades of tastes which would be very pleasing to a connoisseur. It cannot be expected, however, that the laity will cultivate their tastes to these delicate shades. When we bear in mind that the keeping quality of butter is a very necessary property, we are led to believe that the acid-producing bacteria are the more desirable. Out of thirty or forty bacteria isolated from milk, it will be noticed that those which form acid stop their growth when the acid has reached such an amount as to inhibit their growth. The acid formed is usually sufficient to inhibit the growth of other bacteria for a considerable length of time, barring out certain species. The non-acid producing bacteria generally at first curdle the milk, then continue their action by peptonizing the casein giving rise many times to disagreeable products. If this latter class of bacteria should be used in ripening cream, we should expect a continuous change in products from the very beginning of the ripening process to the final decomposition products of butter, hence the keeping qualities would be lowered.

Therefore to obtain a good flavored butter, a good keeping butter and a uniform product, it is necessary to resort to "starters," of the proper kind established only by experimentation.

There are several kinds of starters in use: a sour milk starter, a buttermilk starter, a ripened cream starter and a pure culture starter.

The sour milk starter has been used commonly by dairymen of late and it has furnished satisfactory results in those cases where it has been impossible to obtain pure cultures of bacteria. Close attention, however, must be given to the appearance of the soured milk. It is conceded that a truly loppered milk is best for this purpose, for it represents the typical action of the lactic acid bacteria. It is obtained usually by allowing the cream to rise by the gravity system and after the cream is removed, the skim-milk is utilized as a starter. This starter may be applied to cream obtained from the separator or it may be applied to milk which is set aside according to the gravity system. By the use of such a starter, the cream or milk is inoculated with bacteria desired in the ripening of the cream. These bacteria by being in large quantities gain the ascendency over the other bacteria present in the milk or cream and thus produce their specific action.

The use of buttermilk as a starter, in the same way as the soured skim-milk, has met with considerable success in the making of butter, yet it seems that there are more chances of obtaining poor butter in the use of buttermilk than in the use of the soured skim-milk. This is owing to the fact that the buttermilk is farther removed from the soured milk and is therefore more likely to be contaminated with detrimental bacteria.

In the case of cream, the chances appear still greater, for we are all aware that cream undergoes successive changes more readily than either soured milk or buttermilk.

The pure culture starter is beyond doubt, the most desirable and the most succssful that has been or can be used. Dr. Conn in his B. 41 has given to the dairy world a starter which has yielded excellent results in the quality of the butter. It has been repeatedly tested and has been found to comply with all the properties attributed to it. Dr. Conn has more recently stated that it is a question whether the flavor, the aroma and the keeping qualities can be provided by single species. He has found several lactic acid bacteria which would produce an excellent quality of butter and also several other species which do not belong to the lactic acid class which would produce butter equally as good.

There are several pure culture starters upon the market and most of these belong to the lactic acid class. They usually give satisfactory results, but at times, I fear, owing to commercial enterprises, they are worthless, either from contaminating species or from no growth at all. To furnish a uniform species as a starter in a pure culture requires a very conscientious commercial company.

About the use of the pure culture starters, when once obtained, we may state that they are added to a small quantity of cream which is allowed to ripen, then this cream is added to the gathering for the day. A certain portion of the ripened cream is then used as a starter from day to day, until it is noticed that the action of the pure culture added has been weakened or entirely destroyed. Several modifications of this method could be given but it is unnecessary in this general description.

PASTEURIZATION OF MILK.

CHARLES E. MARSHALL.

Bulletin 147.—Bacteriological Department.

It is not our purpose to give a general discussion of this topic, for a bulletin devoted to that theme has already been issued from this station by Prof. C. D. Smith. We shall be limited to certain experimental data which will add to the fund of information gleaned from the general consideration.

Heretofore the study of Pasteurized milk has been confined to the process in its entirety. Our efforts have been along another line, and we have approached the subject from another standpoint, hoping thereby to gain an insight into the hidden changes of the process. Pasteurization is aimed at the bacteria in milk, and we have endeavored to isolate some of the bacteria remaining after Pasteurization for the purpose of studying them in pure cultures and of ascertaining their relation to Pasteurization.

Our work and consideration may be resolved into the following heads:

1. *The isolation of species from Pasteurized milk—those species left in milk after Pasteurization and not yielding to Pasteurizing treatment.*
2. *Determining the source of such bacteria.*
3. *The study of their actions upon milk.*
4. *The investigation of the thermal death-points of the species isolated.*
5. *The effect of sudden cooling after Pasteurization upon the species isolated.*
6. *The restraining influence of cold upon the species isolated.*
7. *The restraining influence of heat upon the species isolated.*
8. *The restraining influence of heat followed by a low temperature upon the species isolated.*
9. *Suggestions as to the reduction of infection.*
10. *The value of Pasteurization.*

METHODS EMPLOYED.

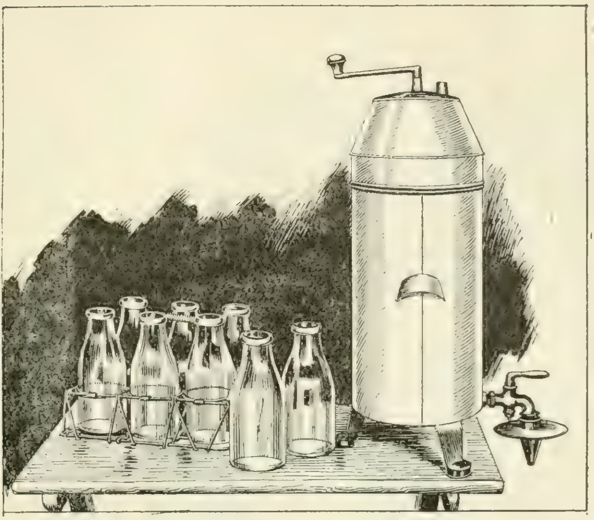
Before discussing the above heads, it may be advantageous to review the methods employed in the process of Pasteurization.

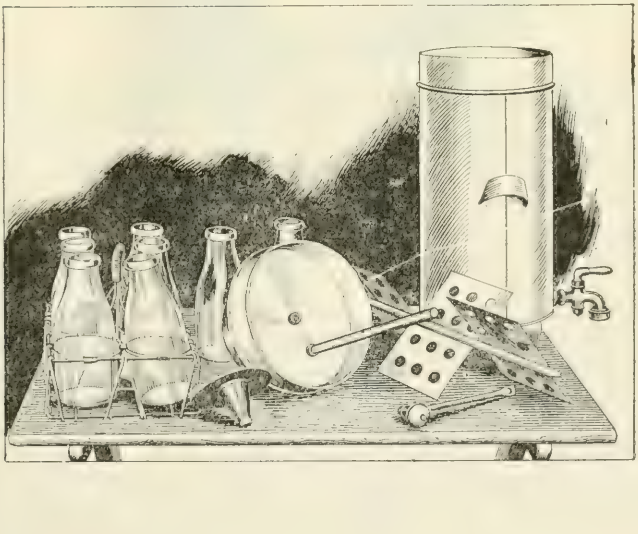
What Constitutes Pasteurization.—Two factors are mainly concerned in Pasteurization, temperature and time. Inasmuch as both are variable, owing to the opinions of different workers, it was necessary to fix upon a definite degree of temperature and period of time. To do this intelligently it is well to bear in mind the principal objects of Pasteurization. Perhaps most vital so far as bacteria are concerned is to have the heating sufficiently high to kill or reduce the virulence of the disease-producing (pathogenic) bacteria. The most important object from the dairyman's view is to keep the milk below a temperature which will produce a cooked flavor or change the composition of the milk. The temperature was placed at 68° C. [155° F.]. The thermal death-points of the pathogenic bacteria which may gain access to the milk probably fall below this, and the change in the composition of the milk and the cooked flavor do not appear in any noticeable degree below 75° C. [167° F.]. The period of time is twenty minutes, a sufficiently long time to attain the objects above.

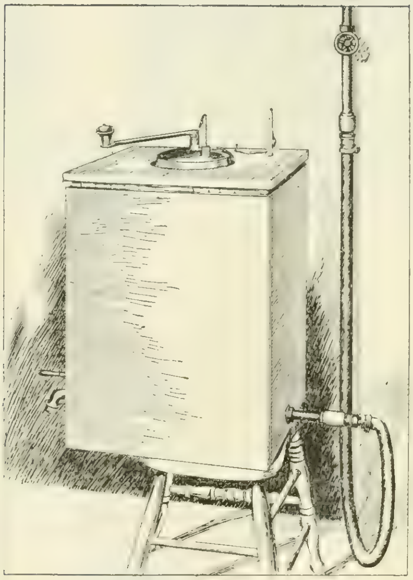
Apparatus Used.—It is a little unfortunate that necessity compelled us to change or modify the apparatus in the midst of our work. Owing to the unsatisfactory results obtained from the first used, we were forced into the modification.

The first used was a shotgun can 8 in. in diameter and 2 ft. deep, with a stirrer inserted through a slit in the cover. The objections to this were, the constant exposure of the stirring rod and its interrupted contact with the milk, the exposure of the thermometer used in determining the temperature of the milk, and the slit in the cover itself, as well as the crude means of getting the milk into the bottles by a siphoning process.

The modification used overcame to a large extent these objections. The truncated conical cover of the shotgun can was made solid with a single perforation which contained a closely-fitting tube, the top of which overlapped a raised portion on the upper side of the cover. The handle was fitted to the upper portion of the cover and to the lower portion of the cover corresponding with the handle above was a cap into which fitted the rod, resting on a pivot in the bottom of the can and carrying the fans used in stirring. The cover overlapped the can by two inches and was made to fit smoothly. So arranged, the cover of the can could be revolved by the handle and in turning the cover, the rod bearing the fans inside revolved. The tube passing through the cover down into the milk was used for the reception of the thermometer in taking the temperature of the milk. Since they all revolved with the cover the tube did not interfere with the fans. In this way, neither the stirrer nor thermometer furnished a source of contamination and there was no opening in the cover to allow bacteria to enter. At the bottom of the can was a brass stop-cock, having a cap screwed over it while Pasteurizing and when ready for drawing off, a mouth-piece screwed on in place of the cap. This mouth-piece was conical in shape that it might fit into the mouth of the bottle and at the base of the cone was a three-inch circular flange to arrest any falling dust.







The can is placed in a galvanized tank lined on the outside with inch matched boards and over which is a wooden cover with a hole in the center for the protrusion of a part of the can cover, and a small hole in the corner for the thermometer.

The bottles used had a neck so fitted that a hot paraffined paste-board circular cover could be pushed down tightly and covered farther with paraffin.

The Process.—The apparatus and bottles were steamed for thirty minutes before using. After the milk had been placed in the can and the can in the tank, the parts were adjusted for conducting the work of heating. The water in the tank was kept equal in heighth with the milk in the can and the steam turned on from time to time as required to keep the water at the proper temperature, which was not allowed to exceed 70° C. [158° F.]. During the heating the milk was stirred constantly. As soon as 68° C. [155° F.] was reached by the milk, the stirring was stopped and the water in the tank was held at 68° C. [155° F.] for twenty minutes. At the expiration of twenty minutes, the can was removed from the heating tank and placed into a cooling tank containing a freezing mixture and the milk was constantly stirred while cooling. When the temperature had fallen to 10° C. [50° F.] or below, the can was removed and the milk drawn off into bottles. In drawing off the milk, the cap was first removed from the faucet and the mouth-piece substituted, care being used in handling the mouth-piece where the milk does not touch it. A little of the milk was drawn off at first before drawing into the bottles to rinse the mouth-piece, although sterilized. When the bottle was nearly filled the milk was turned off and the hot paraffined cap immediately placed on the mouth of the bottles. In handling the bottles, they were taken from the sterilizer when wanted, in an inverted position only and the mouth was not turned uppermost till it was adjusted to the mouth-piece and underneath the three inch flange.

THE STUDY OF SAMPLES.

After Pasteurization two bottles were brought to the laboratory, and also, with them, two bottles of the same lot of milk, put up with sealed mouths just as the other but un-Pasteurized. These latter were regarded as controls. In the first half of the samples the data is very limited, but in the second half, care was exercised in several details which may not have any direct value in the work, yet these very details will help to check the work; consequently a history of each sample which may be referred to when desired, will be appended.

But before considering the samples by themselves, we wish to say that one sample bottle of the Pasteurized milk of each lot was opened and several plates were made from it; also it was tested for acidity. One of the un-Pasteurized sample bottles was also opened and tested for acidity.

The other sample bottle of each lot of Pasteurized milk and the other of each lot of un-Pasteurized milk were placed away at room-temperature and when changed were tested for acidity, odor and other qualities, as shall be noted in the history of each.

Sample.	Time of milking.	Time of receipt in laboratory.	Time required in raising to 68°C.	Time of heating at 68°C.	Time required in cooling to 10°C or below.	Time of Pasteurizing the milk.	Change of milk first noticed.		Condition of Pasteurized milk when changed.	Reaction of Pasteurized milk when changed.	Condition of weather at time of change.	Test for lactic acid.	Per cent of acidity when received, un-Pasteurized.	Per cent of acidity when received, Pasteurized.	Per cent of acidity when changed, un-Pasteurized.	Per cent of acidity when changed, Pasteurized.	Odor of Pasteurized milk when changed.
							Pasteurized.	Un-Pasteurized.									
A	--------	Nov. 12	57½ min.	20½ min.	16 min	----------	40 hrs.	--------	Loppered.	Acid.	Warm.	----------	----	----	----	----	
B	--------	" 17	30 "	23 "	23 "	----------	48 "	--------	"	"	"	----------	----	----	----	----	
C	--------	" 21	34 "	20 "	20 "	----------	48 "	--------	"	"	"	----------	----	----	----	----	
D	--------	" 23	36 "	21 "	23½ "	----------	42 "	--------	"	"	"	----------	----	----	----	----	
E	--------	" 24	30 "	20 "	26 "	----------	45 "	--------	"	"	"	----------	----	----	----	----	
F	--------	" 25	26 "	23 "	16 "	----------	47 "	--------	"	"	"	----------	----	----	----	----	
G	--------	" 27	41 "	21 "	40 "	----------	60 "	--------	"	"	Cool.	+	----	----	----	.315	
H	--------	" 28	47 "	20 "	27 "	----------	64 "	-----	"	"	Cold.	+	----	----	----	.446	
I	--------	Dec. 1	30 "	20 "	23 "	----------	62 "	62 hrs.	"	"	Mean 11° F	+	----	----	.441	.126	
J	--------	" 2	27 "	21 "	20 "	----------	60 "	60 "	"	"	" 13⅓°F	+	----	----	.517	.139	
K	--------	" 3	33 "	20 "	18 "	----------	103 "	103 "	"	"	" 18⅔°F	+	----	----	.528	.189	
L	--------	" 4	41 "	20 "	17 "	----------	79 "	79 "	"	"	" 28° F	+	----	----	.491	.339	
M	--------	" 5	30 "	20 "	12 "	----------	72 "	72 "	"	"	" 33⅓°F	+	----	----	.561	.441	
N	1 p. m.	3:40 p. m. Jan. 11	19½ "	24½ "	28 "	2:03 p. m.	147 "	116 "	Granular curd.	"	" 24° F	+	.164	.164	.441	.189	Sweetish.
P	"	" " " 12	12 "	20 "	28 "	1:54 "	100 "	96 "	Fine & loose "	"	" 16⅓°F	+	.151	.151	.503	.327	Taffy odor.
O	"	3:30 " " 14	13 "	21 "	28 "	1:55 "	90 "	82 "	" " "	"	" 23⅓°F	+	.176	.176	.476	.406	Sweetish.
Q	"	" " " 15	18 "	22 "	23 "	1:50 "	96 "	72 "	" " "	"	" 27⅓°F	+ Un-P. −P.	.164	.164	.466	.152	Sweet cider.
R	"	" " " 18	17 "	30 "	19½ "	1:57 "	79 "	55 "	" " "	"	" 17° F	+	.176	.176	.441	.378	Taffy odor.
S	"	3:55 " " 19	24 "	20 "	25 "	1:36 "	96 "	72 "	Granular "	"	" 14⅓°F	+	.165	.165	.441	.416	" "
T	"	3:00 " " 26	17 "	20 "	19 "	1:27 "	88 "	64 "	" "	"	" 4⅔°F	+	.189	.189	.579	.492	Sour milk odor.
U	"	3:30 " Feb. 2	23 "	22½ "	16½ "	1:47 "	--------	48 "	--------------	"	" 29° F	+	.189	.189	.477	.414	Sweetish
V	"	3:45 " " 4	18 "	23 "	16½ "	1:55 "	90 "	48 "	Scarcely marked.	"	" 27½°F	+	.189	.189	.402	. 39	Sour milk odor.
W	"	3:00 " " 8	23 "	20 "	12 "	1:31 "	72 "	36 "	Loppered.	"	" 29⅓°F	+	.176	.176	.428	.402	" " "
X	"	3:00 " " 10	13 "	25 "	18 "	1:42 "	60 "	48 "	--------------	"	" 27⅓°F	+	.189	.189	.516	.403	" " "
Y	"	4:00 " " 11	17 "	20 "	45 "	2:38 "	79 "	48 "	"	"	" 23⅓°F	+	.202	.202	.453	.415	" " "
Z	"	3:30 " " 12	11 "	23 "	23 "	1:50 "	74 "	50 "	"	"	" 25° F	−P. + Un-P.	.189	.189	.529	.157	

It is evident from *Sample I* to *Sample U* that there is no difference in the length of time between the change in the Pasteurized sample and its control, although the measure of acidity differs very markedly in samples I, J and K. From this the conclusion was drawn that the Pasteurizing apparatus used was not sufficiently accurate. There were too many entrances for foreign bacteria by way of the rod, the slit in the cover and the pouring into bottles. This resulted in the author's designing another Pasteurizing apparatus based upon the shotgun can and described elsewhere. The samples from N to Z were prepared in the latter apparatus.

The last half of samples furnished interesting data. The reaction of both the bottle of the Pasteurized milk and that of the un-Pasteurized was taken from the duplicate samples of each immediately upon their receipt in the laboratory. The indicator used was phenol-phthalëin. It will appear from a study of this phase of the work, that although the time after milking was about the same, the acidity varied considerably, and that, as has been stated by several writers, the reaction began to change from the amphoteric directly after milking. This was not the primary purpose of this work, however; we wanted a mark from which to measure the change in the milk, consequently the determination of the reaction at this stage provided us with a starting point.

The bottles were watched closely in the laboratory and as soon as the thickening of the milk was noticed, the time was noted from the hour of receipt. This was thought a fairer test of the keeping qualities than the placing of the bottles in a refrigerator, although the temperature of the latter could be kept more constant. Inasmuch as the keeping qualities are determined in hours, a tabulated statement will perhaps give us a better notion of the comparative values of the Pasteurized and un-Pasteurized milk. The temperature of the room varied from 45° F. to 70° F.

Samples	N	P	O	Q	R	S	T	U	V	W	X	Y	Z
Pasteurized	140	100	90	96	79	96	88	—	90	72	60	79	74
Un-Pasteurized .	116	96	82	72	55	72	64	48	48	36	48	48	50

It must be borne in mind that the variability of the change among the different lots is due to the rise and fall of temperature during the work, and that each lot consisting of Pasteurized and un-Pasteurized bottles were treated identically the same and were under exactly the same conditions. Although the relation of temperature differs between the different lots, it does not affect the relation of the bottles of the same lot, consequently the above table offers no direct bearing upon the work when read from right to left, but its significance comes from reading up and down.

When the milk either Pasteurized or un-Pasteurized became the least thickened, the acidity was tested and recorded in each bottle of every lot. Again by this act we gain some idea of the progress of the change as in the number of hours and likewise the kind of change, whether acid or alkaline. At the same time, Uffelmann's test for lactic acid was applied.

The following tables will show the per cent of acidity in the Pasteurized and un-Pasteurized samples at the time when a change was first noted.

Sample ...	N	P	O	Q
Pasteurized ..	.189 in 140 hrs.	.327 in 100 hrs.	.406 in 90 hrs.	.152 in 96 hrs.
Un-Past'zed	.441 in 116 hrs.	.503 in 96 hrs.	.479 in 82 hrs.	.466 in 72 hrs.

Sample	R	S	T	U
Pasteurized ...	.378 in 79 hrs.	.416 in 96 hrs.	.491 in 88 hrs.	.414
Un-Pasteurized	.441 in 55 hrs.	.441 in 72 hrs.	.579 in 64 hrs.	.477 in 48 hrs.

Sample	V	W	X	Y
Pasteurized ..	.239 in 90 hrs.	.402 in 72 hrs.	.403 in 60 hrs.	.415 in 79 hrs.
Un-Pasteurized	.402 in 48 hrs.	.428 in 36 hrs.	.516 in 48 hrs.	.415 in 48 hrs.

Sample	Z
Pasteurized	.151 in 74 hrs.
Un-Pasteurized	.529 in 50 hrs.

Closely connected to the above is the response to the lactic acid test.

Samples......	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Lactic acid...	+	+	+	—	+	+	+	+	+	+	+	+	—	Pasteurized milk.
Lactic acid...	+	+	+	+	+	+	+	+	+	+	+	+	+	un-Pasteurized milk.

The following table will show the gain in the per cent of acidity from the time of the test made upon the receipt of the milk in the laboratory to the time when the first change was noticed.

Sample ...	N	P	O	Q
Pasteurized.	.025 in 140 hrs.	.176 in 100 hrs.	.230 in 90 hrs	—.012 in 96 hrs.
Un-Past'zed	.277 in 116 hrs.	.352 in 96 hrs.	.303 in 82 hrs.	.302 in 72 hrs.

Sample	R	S	T	U
Pasteurized . .	.202 in 79 hrs.	.251 in 96 hrs.	.302 in 88 hrs.	.225
Un-Pasteurized	.265 in 55 hrs.	.276 in 72 hrs.	.390 in 64 hrs.	.288 in 48 hrs.

Sample	V	W	X	Y
Pasteurized ...	.050 in 90 hrs.	.226 in 72 hrs.	.214 in 60 hrs.	.213 in 79 hrs.
Un-Pasteurized	.213 in 48 hrs.	.252 in 36 hrs.	.327 in 48 hrs.	.251 in 48 hrs.

Sample	Z
Pasteurized	—.038 in 74 hrs.
Un-Pasteurized	.340 in 50 hrs.

THE ISOLATION OF SPECIES FROM PASTEURIZED MILK.

Many difficulties are encountered in a study of this nature. Only the bacteriologist can appreciate what it means to separate numerous bacteria from milk, work out their history and establish their identity.

Although it was not our aim to work out in sufficient detail to establish identity, for this would require months with each species, it was our lot to study these bacteria isolated, sufficiently to give them identities of their own. It was exceedingly trying to accomplish this, for where there are two or three persistent differential characteristics prevailing between species, and when all other characteristics are in common, the task is important and very complicated.

It has been the growing belief of some workers that where species are practically identical, with the exception of two or three characteristics, they could perhaps be brought under a single species, if the proper conditions were obtained. There is good ground for this opinion which need not be discussed in this connection.

In our work all the different species were studied side by side under the same conditions and cultivated upon the same media so far as it was practicable. If we were to give the history of each showing a single difference and even more, our number of species would be greatly increased, but we have classified together those which seemed closely allied, and could reduce the number still more, but it would probably be to the detriment of our work. Our fear is, we have now overlooked some interesting characteristics because of our desire to reduce the number of species.

We could discuss the relation of some of these species to the hay bacillus, the potato bacillus and others, but because of the indefiniteness of lines of distinction, we must refrain from making any suggestions. The limited histories must convey the importance of the bacteria and the information where they may belong.

Of the 39 varieties isolated and studied together the histories of only 19 varieties will be given, since we think so many of them are near enough alike, but not exactly the same, to be classified together. After the histories have been given of these 19, we shall be inclined to suggest the grouping of others.

The grouping of these bacteria may be represented as follows:

Let the number stand for the laboratory number of the micro-organism and the letter, the sample from which the micro-organism was taken.

Numbers 3, 6, 9, and 12 do not come from any of the samples listed, yet they were taken from Pasteurized milk.

3— , 97—Y.
6— , 12— , 122—P, 123—O, 124—N, 125—Q.
9— , 16—B, 21—C.
29—E.
30—F.
32—H, 40—Z, 82—T, 86—W.
38—I.
43—J.
44—K.
45—M.
46—M.
48—L, 37—G, 64—P, 65—Q, 73—R, 77—S, 81—T.
60—O.
62—P, 57—O.
107—F.

112—G.
115—I.
116—J.
117—L.

No. 3.

Source.—From Pasteurized milk not recorded in this bulletin. Method of Pasteurizing, same as in first half of samples.

Form and grouping.—Bacillus. Its thickness varies from ¾ m to 1 m; its length from 2½ m to 6 m. Ends are round. It may form in short threads, but is usually in pairs or single.

Spores.—It forms median spores.

Protoplasm.—The protoplasm of this bacillus is usually homogeneous, but just before sporulation it becomes markedly granular.

Temperature.—Grows best at 28° C. 15° C. checks its growth materially, scarcely developing at all. Withstands 93° C. for 20 min., but is killed at 96° C. for the same time.

Motion.—Very motile. It has a progressive tumbling motion.

Colonies.—The border is irregular and broken, yet its outline is sharp and distinct. Instead of spreading out in a thin plaque, it is rather abrupt. From the border are well-defined lines much darker than the surrounding mass, which run to the center. These markings resemble small crevices extending from the border to the center. At the center there is a dark mass which obliterates all the markings. The whole effect is much like looking down upon a summer rose with its stamens and conglomerate center from which the petals radiate. The color of the colony is dark yellowish brown.

Gelatin tube-cultures.—The growth is slight along the line of inoculation. At the surface it is more noticeable, and it soon begins to liquefy the gelatin. In the liquefaction of the gelatin it has the peculiarity of extending over the entire surface of the tube, but does not extend down the line of inoculation. After liquefying a third the distance down the tube, its growth is checked and it remains apparently inactive, yet after some time the liquefaction extends to the bottom. Quite early in its development a scum forms on the surface of the tube.

Agar inclined tube-cultures.—It spreads over the surface of the agar in a translucent and blister-like mass. From this, after a time, cream-white spots arise.

Bouillon cultures.—A wrinkled scum forms on surface; the liquid beneath is almost clear and there is no sediment at the bottom.

Milk cultures.—Milk is first curdled, then peptonized slowly but completely.

Potato tube cultures.—Blisters resembling water blisters extend over surface. These eventually dry down into a granular mass which finely becomes wrinkled and of a dark brown color.

Blood serum cultures.—Serum is completely peptonized.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Is almost an obligate aërobic bacillus.

Odor.—The odor of rotting potatoes.

Acids.—No acid produced in any of the cultures. Upon the addition of lactose (milk sugar) there was no formation of acid.

Behavior to gelatin.—Liquefies.

Gas production.—None observed even in the presence of carbohydrates.

No. 6.

Source.—Taken from Pasteurized milk which has not been recorded in this bulletin.

Form and grouping.—A bacillus. Its thickness varies from ¾ m to 1 m; and its length from 3 m to 7 m. It has square ends and is usually arranged in short threads.

Spores.—Forms median spores in old cultures.

Protoplasm.—Homogeneous even to the time of sporulation. Sporogenic granules are not so prominent as many times noticed.

Motion.—It is sluggishly motile. Its movement is that of a snake.

Staining reaction.—Stains readily with ordinary aniline stains.

NOTE.—m stands for Greek letter mu or micron, which is about 1-25,000 of an inch.

Temperature.—Its optimum temperature is 28° C. Scarcely grows at 15° C. Lives at a temperature of 96° C. for 20 min., but is killed at 100° C. for the same time.

Colonies.—The center before liquefaction occurs is bright and glistening and of a very light color, almost translucent. However, it soon becomes liquefied. In the liquid portions are observed small patches of thick masses of bacteria floating about from one place to another. From the circular border radiate fine fiber-like processes which are quite uniform in length and resemble the ray crown.

Gelatin tube-cultures.—At first there is a slight growth along the line of inoculation. After a few hours longer, a funnel-shape liquefaction occurs only at the surface, and this gradually extends across the tube until the upper portion of the tube is liquefied and the lower portion entire. About this time a scum forms on the surface. Having reached this point in its stage of development, its progress is not rapid and the remaining gelatin in the tube is very slow in liquefying.

Agar inclined tube-culture.—A dry spreading growth adhering closely to the agar in a scum-like sheath. Along the streak the growth is much heavier.

Bouillon culture.—Wrinkled dark scum on surface, beneath which the liquid is clear. No sediment forms at the bottom.

Milk cultures.—Milk is at first curdled then peptonized, eventually becomes clear but quite dark.

Potato tube-cultures.—Spreading dirty white growth over surface of potato. It gradually becomes a creamy-white and when it grows old is wrinkled and mealy.

Blood serum tubes.—Serum is peptonized only slightly underneath the growth, which is creamy white.

Growth.—Very rapid.

Pigment.—None.

Oxygen conditions.—Grows best in oxygen, very slightly anaërobically.

Odor.—None perceptible.

Acids.—No acid produced even in presence of carbohydrates. Lactose had no influence in changing this condition.

Behavior to gelatin.—Liquefies gelatine readily.

Gas production.—No gas observed in any of the cultures, not even in presence of carbohydrates.

No. 9.

Source.—Pasteurized milk not recorded in this bulletin; also samples B and C.

Form and grouping.—Its thickness is 1 m to 1¼ m, and its length varies from 3 m to 9 m. Ends are slightly rounded. Forms in long threads, short threads and single.

Spores.—It produces median spores.

Protoplasm.—Homogeneous until the formation of spores at which time it becomes markedly granular.

Motion.—It has a slow progressive and serpentine movement.

Staining reaction.—Stains readily with ordinary aniline stains.

Temperature.—Not killed at 90° C. for 20 min., but killed at 93° C. for 20 min. Scarcely grows at 15° C. Optimum temperature is about 30° C.

Colonies.—At first the colony appears light and crystalline, afterward becoming much darker. Soon after developing it begins to liquefy the surrounding gelatin. From its border is a radiating mass of fine and straight processes but this appearance may be almost completely lost in further liquefaction. The contents of the body as soon as liquefaction begins assume no definite arrangement; patches consisting of masses of bacteria may be seen floating about in the peptonized gelatin. While the above is the usual course of development, the colony may in the early stage of its development resemble a composit flower and again may form in concentric rings of different shades and density.

Gelatin tube-cultures.—The growth is along the entire line of inoculation. Almost as soon as the growth is visible, liquefaction begins and extends to the end of the puncture, liquefying as fast at the bottom of the puncture as at the top. In this way the gelatin is liquefied very rapidly. There is no clearing after liquefaction, the suspended material of a flocculent nature remains as when first formed. The scum which forms on the surface, however, falls eventually to the bottom.

Agar inclined tube-cultures.—It usually spreads over the entire surface in a moist and uniform mass of a creamy white consistency. As the culture becomes old, it dries down in wrinkles.

Bouillon cultures.—Scum forms on top. It is thin and falls to the bottom after a few days. The body of the bouillon remains cloudy and does not become clear.

Potato cultures.—Raised mealy white growth which is not inclined to spread. In this respect, it resembles very closely Bacillus Subtilis.

Milk cultures.—Curdles milk in a very short time, then peptonizes it rapidly.

Blood serum cultures.—Completely peptonizes the serum.

Growth.—Very rapid.

Pigment.—None.

Oxygen conditions.—It seems to grow as readily anaërobically as aërobically.

Odor.—No odor perceptible.

Acids.—No acid produced in any of the cultures, not even when lactose or glucose was added.

Behavior to gelatin.—Liquefies the gelatin very rapidly.

Gas production.—No gas formation observed.

No. 29.

Source.—Was obtained from Pasteurized milk *E*.

Form and grouping.—Its thickness varies from $\frac{1}{3}$ m to $\frac{2}{3}$ m, its length from 2 m to 7 m. The ends are pointed, and the bacilli usually occur in threads of three and four.

Spores.—No spores were observed.

Protoplasm.—The protoplasm is homogeneous and the lines of fission are very distinct.

Motion.—Very actively motile. It has a progressive tumbling motion.

Staining reaction.—Stains readily with ordinary aniline stains.

Temperature.—Withstands 80° C. for 20 min., but is killed at 85° C. for the same time. Its best temperature for growth is 30°–32° C. Below 20° C. it grows very slowly.

Colonies.—The first stage in the development of the colony is a glistening, granular and regularly formed body. As it grows larger, fine and interwoven threads are noticed to proceed from the border extending to some distance into the gelatin. The body of the colony does not verge gradually into the threads but retains its original and definite shape intact through all of its stages of development. The bright glistening appearance remains and the delicate thread like shoots are almost imperceptible.

Gelatin tube-cultures.—The growth is along the entire line of inoculation, simply a streak at first, with perhaps a slightly heavier growth at the surface. The streak gradually widens out into a funnel shape and extends to the bottom of the tube. The growth is a cloudy path through the gelatin and although it appears as liquefied, there is no liquefaction present.

Agar inclined tube-culture.—Almost an invisible sheath covers the surface of the agar along the streak of inoculation. It is translucent, crystalline and moist. There is no spreading over the surface. Isolated colonies may be seen along the streak.

Bouillon cultures.—A homogeneous clouded appearance with a small amount of sediment at the bottom. Does not clear up after several days.

Milk cultures.—Produces an acid but does not change the appearance of the milk. It seems to remain unaffected.

Blood serum cultures.—No change in the serum.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions,—Grows anaërobically nearly as well as aërobically.

Odor.—None.

Acids.—Grown in the presence of lactose, an acid is produced. In litmus-lactose gelatin the litmus is reddened from the surface downward along the growth.

Behavior to gelatin.—Does not liquefy gelatin.

No. 30.

Source.—Pasteurized milk *F*, *H*, *J*, *M*.

Form and grouping.—Bacillus. Its thickness varies from $\frac{1}{2}$ m to 1 m and its length from 2 m to 7 m. Has square ends and is usually single.

Spores.—Median spores are formed. They are quickly set free from the parent cell.

Protoplasm.—Protoplasm maintains a marked homogeneity to time of sporulation.

Motion.—A tumbling progressive movement. Quite rapid.

Staining reaction.—Stains readily with ordinary aniline stains.

Temperature.—Withstands 80° C. for 20 min., but is killed at 85° C. for 20 min. Its optimum temperature is 28° C.–30° C. Below 16° C. it grows very slowly.

Colonies.—It forms in a light brown colony in its first stage. Its border is even and the contour circular. Concentric rings soon appear of different shades of density, and from the border radiate fine thread-like processes. Liquefaction sets in and the outline of the liquefied gelatin is irregular and the colony becomes a nucleated mass with long fibers radiating from the nucleus and extending throughout the liquefied portion. The colony in the last stage has few features left of the first stage. In liquefying, the colony spreads over the surface rather than in a deep cup manner.

Gelatin tube-cultures.—A very slight growth appears along the line of inoculation. At the top the growth soon spreads out in a wide and shallow funnel and finally liquefies the surface of the tube to the depth of a half inch and then apparently stops or grows so slowly that observation ceases. It is evident that the growth is dependent upon the oxygen supply.

Agar inclined tube-culture.—A pearly beaded growth occurs along the line of inoculation; its color is yellowish white. It finally spreads out in a creamy layer over the surface of the agar.

Bouillon cultures.—Cloudiness occurs which does not clear up readily. Small crusty patches appear on the surface, and a small amount of sediment rests at the bottom.

Milk cultures.—Peptonizes milk but slowly. Clears up only after a long time.

Potato tube-cultures.—A yellowish white growth drying down into a wrinkled scum.

Blood serum-cultures.—Peptonized completely.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Requires the presence of free oxygen for growth.

Odor.—Odor of decomposition.

Acids.—No acids produced in the presence of lactose, glucose or in other media.

Behavior to gelatin.—Liquefies rapidly.

No. 32.

Source.—This micro-organism was found in sample *H* of Pasteurized milk.

Form and grouping.—Bacillus. Thickness varies from ½ m to 1 m, and its length from 2 m to 6 m. It does not form threads or pairs.

Spores.—Median spores formed and are quickly set free.

Protoplasm.—The protoplasm is homogeneous, not changing to any great extent at time of sporulation.

Motion.—It has a tumbling progressive motion.

Staining reaction.—Stains readily with the ordinary aniline stains.

Temperature.—Its optimum temperature is 30° C.–32° C. Growth is checked below 15° C. It is killed at 90° C. for 20 min., but withstands 85° C. for the same time.

Colonies.—The colonies are brown and granular at first. The border is regular and well defined. As it grows, there is a thin layer formed over the surface of the gelatin, with an irregular and somewhat indistinct border. At the center is a decided nuclear mass. Developing farther, the gelatin liquefies underneath the colonies, and leaves only the nucleus as a tangible form.

Gelatin tube-cultures.—The growth starts along the whole line of puncture, a little more rapidly at the surface than at the bottom. Liquefaction then sets in at the surface, forming a broad and shallow funnel: at the same time the growth becomes more pronounced along the lower line of inoculation. The whole surface of the tube is finally liquefied to the depth of a third of the tube, and from this point liquefaction is exceedingly slow.

Agar inclined tube-cultures.—It produces a creamy-white and heavy growth along the line of inoculation which spreads out over the surface in scum. As it grows older, wrinkled indentations radiate from the streak.

Bouillon cultures.—A clouded appearance of permanence. Sediment found at bottom in very minute quantities. A few patches of bacteria are seen floating on the surface.

Milk cultures.—Peptonization takes place very slowly.

Potato cultures.—A yellowish white mass appears which dries down into a wrinkled mass.

Blood Serum.—Serum is peptonized completely.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Grows much better in the presence of oxygen.

Odor.—Rotten potato odor.

Acids.—Acid is not produced in any of the cultures—not in the presence of lactose.

Behavior to gelatin.—Liquefies gelatin very rapidly.

No. 38.

Source.—Pasteurized milk I.

Form and grouping.—Bacillus. Its thickness varies from 1 m to 1¼ m; its length from 4 m to 10 m. It appears individually and in short threads.

Spores.—Spores are rather slow in developing but median spores appear in an old culture.

Protoplasm.—There is no tendency for the protoplasm to become granular.

Motion.—Very actively motile. Has a progressive snake like motion.

Staining reaction.—Stains readily with ordinary aniline stains.

Temperature.—Grows best at 28° C.–30° C. Withstands 85° C. for 20 min., but is killed at 90° C. for the same time. Grows very slowly indeed below 20° C.

Colonies.—Their first appearance is in yellowish-brown pin-head dots. They are crystalline and bright, with a regular border. Soon they send out root-like shoots from the border which make their way through the gelatin in rapid growth. Each shoot has a knotted aspect, and although they are quite distinct a distance from the colony, yet near the body of the colony they are considerably matted. The regular edge of the original colony is completely lost. The color has become very dark, almost black. Liquefaction is hardly visible.

Gelatin tube-cultures.—The growth is almost wholly at the surface, spreading out upon the surface for a short distance. Just beneath the surface, along the line of inoculation, it sends out branches. The development at the surface and the branches continue to increase until the inverted pine tree appears. The only liquefaction that occurs is directly underneath the colony and that is very limited; only an indentation of the gelatin is it to be noticed.

Agar inclined tube-cultures.—A grayish-white film spreads over the surface. It is moist and almost transparent.

Bouillon cultures.—There is a dense wrinkled scum on the surface; below, the liquid is clear. No sediment appears at the bottom.

Milk cultures.—Milk is completely peptonized, becoming watery.

Potato tube-cultures.—There is a grayish-white blister-like growth which dries down into an irregular mass.

Blood serum cultures.—Serum is completely peptonized.

Growth.—Slow.

Pigment.—None.

Oxygen conditions.—Can adapt itself to anaërobic conditions, but grows best in presence of oxygen.

Acids.—No acids produced even in the presence of lactose or glucose.

Behavior to gelatin.—Liquefies gelatin very slowly.

Remarks.—Some trouble was experienced in making this bacillus grow upon media which seemed very suitable for the others.

No. 43.

Source.—Pasteurized milk *J.*

Form and grouping.—Bacillus. The thickness of this bacillus varies from ½ m to 1 m; its length from 2 m to 7 m. Its ends are square. The bacilli appear single or in pairs.

Spores.—Median spores are formed.

Protoplasm.—The protoplasm is homogeneous.

Motion.—It has a tumbling and progressive motion.

Staining reaction.—The ordinary aniline stains act readily.

Temperature.—Withstands 93° C. for 20 min., but is killed at 96° C. for the same time. Its optimum temperature is 25° C.–29° C. Grows very slowly below 20° C.

Colonies.—The colony begins as an irregular mass of a very dark color as though the bacteria were massed in a heap. Fine threads soon begin to radiate from this mass and continue to grow till they form a complete whorl. The threads are interwoven with each other and are of a very light crystalline appearance. Liquefaction takes place so slowly that it is not noticeable in the plates.

Gelatin tube-cultures.—The growth may first be seen along the entire line of inoculation. At the surface the growth increases till a small deep cup is formed. It deepens considerably and the surface of the gelatin is slowly liquefied. As soon as the liquefaction extends down a third of an inch, the growth and liquefaction are exceedingly slow.

Agar inclined tube-cultures.—Along the streak there is a creamy white growth which is confined to the limits of the streak.

Bouillon cultures.—An even cloudiness of tube. A small amount of fine sediment occurs at the bottom of the tube. A wrinkled scum forms on the surface.

Milk cultures.—Milk is completely peptonized, yet a milky color remains.

Potato tube-cultures.—A brownish growth which dries down into a thin wrinkled layer.

Blood serum cultures.—Serum is completely peptonized.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Oxygen necessary to its growth. Under anaërobic conditions, very little growth.

Odor.—No marked odor.

Acids.—No acids produced in any of the cultures. Lactose and glucose give rise to none when put into the cultural media.

Behavior to gelatin.—Liquefies very slowly.

NO. 44.

Source.—Taken from Pasteurized milk *K*.

Form and grouping.—Bacillus. Its thickness varies from ½ m to ⅚ m, and its length from 2½ m to 5 m. The ends are round. It forms in short threads but is usually found single.

Spores.—Median spores are formed.

Protoplasm.—The protoplasm is somewhat granular.

Motion.—It has a very active, progressive, snake-like motion.

Staining reaction.—Stains readily with the ordinary aniline stains.

Temperature.—Optimum temperature is 24°–28° C. Grows very slowly below 18° C. It is killed at 85° C. for 20 min., but withstands 80° C. for the same time.

Colonies.—From the start they resemble a tangle of threads. When quite small there may be noticed several threads of this micro-organism crossing each other. This crossing and recrossing continues until the center is one dense black mass. The threads which were originally single become entangled with each other until several threads unite in forming a large and dense root-like process. Several of these will be found surrounding the colony. The colonies grow to a very large size and their radiating shoots may be readily seen with the naked eye.

Gelatin tube-cultures.—The growth along the line of puncture becomes very marked after a few hours, a little heavier at the surface than at the bottom. Fiber-like processes are soon seen coursing straight out from the line of growth, and these continue to grow till they have nearly reached the tube. These branches or fibers are not uniform throughout their length, but give a knotted appearance. Liquefaction takes place very slowly, only at the surface where it forms a very shallow cup after several days.

Agar inclined tube-cultures.—A slight and almost transparent growth takes place along the line of inoculation. It is moist and soon spreads over the surface of the agar.

Bouillon cultures.—There is a dense wrinkled scum on the surface. The liquid is clear and no sediment appears at the bottom of the tube.

Milk cultures.—The milk is peptonized, but very slowly.

Potato tube-cultures.—A grayish white mass spreads over the surface. It is uneven and scum-like, and finally becomes mealy.

Blood serum-cultures.—Serum is completely peptonized.

Growth.—Fairly rapid.

Pigment.—None.

Oxygen conditions.—Grows both aërobically and anaërobically, but best aërobically.

Odor.—None perceptible.

Acids.—No acid is produced even in the presence of lactose or glucose.

Behavior to gelatin.—Liquefies very slowly.

No. 45.

Source.—Pasteurized milk *M.*

Form and grouping.—Bacillus. Thickness varies from ½ m to 1 m; its length from 2 m to 7 m. It is found single and in short threads.

Spores.—Median spores are formed.

Protoplasm.—The protoplasm is homogeneous but is decidedly granular just before sporulation.

Motion.—There is a progressive tumbling motion.

Staining reaction.—Stains very readily with ordinary aniline stains.

Temperature.—It withstands 85° C. for 20 min., but is killed at 90° C. for the same time. Its optimum temperature ranges from 23° C.–27° C., and its growth almost ceases below 15° C.

Colonies.—There appears at first a light crystalline mass with a well defined border, which has several short fibers protruding from it. As the colonies grow older, the centers become very dark and the outer zone is only a shade lighter. The border has a dense array of fine fiber-like threads radiating from it, and they are all of nearly uniform length. Liquefaction soon takes place and the colony becomes unrecognizable.

Gelatin tube-cultures.—The growth appears along the entire line of inoculation, but much more rapidly right at the surface, where it slowly spreads out and liquefies, forming a wide shallow cup. It continues to spread at the surface till the whole surface is involved, but does not reach down into the tube. About one-fifth of the tube is liquefied and then it stops.

Agar inclined tube-cultures.—Thick slimy yellowish growth along line of inoculation. There are arms projecting from this line which are short and thick.

Bouillon cultures.—Bouillon becomes densely cloudy with a granular sediment on the bottom and a granular scum on the surface.

Milk cultures.—Milk is peptonized very slowly.

Potato tube-cultures.—A yellowish white growth forming in a wrinkled scum.

Blood serum-cultures.—Serum is completely peptonized.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Free oxygen is essential to growth.

Odor.—No distinguishable odor.

Acids.—No acids produced. Lactose or glucose have no influence

Behavior to gelatin.—Liquefies gelatin rapidly.

No. 46.

Source.—Pasteurized milk *U.*

Form and grouping.—Bacillus. It has square ends and is usually single, yet short threads are found. Its thickness varies from ½ m to 1 m and its length from 2 m to 7 m.

Spores.—Median spores are formed. On agar, in a few days' time, there seems to be spores only, the vegetative forms have entirely disappeared.

Protoplasm.—The protoplasm is homogeneous, not becoming markedly granular before sporulation.

Motion.—There is a tumbling progressive movement.

Staining reaction.—Take the ordinary aniline stains very readily.

Temperature.—It grows best at a temperature of 28°–30° C. Below 20° C. it grows very slowly. Withstands 93° C. for 20 min., but is killed at 96° C. for the same time.

Colonies.—The young colonies are brown and have an irregular outline. In the middle is a nucleus somewhat darker. From the border are several radiating fibers. As the colonies become older the nucleus remains distinct but the remainder of the colony gradually verges off into a fine misty and fibricated mass, gradually fading away into a single layer of bacteria and only a few threads.

Gelatin tube-cultures.—At first there is a growth along the entire line of inoculation continuing to develop, however, only at the top where a deep cup is formed. The liquefaction soon reaches across the surface of the tube, but does not extend down very far. Just below the liquefied gelatin there are fibers proceeding from the line of inoculation through the solid gelatin.

Agar inclined tube-cultures.—A raised white creamy growth is found along the streak of the needle. It is not inclined to spread.

Bouillon cultures.—Granular patches are found on the surface. The body of the bouillon is evenly clouded, and there is some fine sediment found at the bottom of the tube.

Milk cultures.—Milk is peptonized very rapidly.

Potato tube-cultures.—A yellowish-white growth is obtained which eventually dries into a wrinkled mass.

Blood serum cultures.—Serum is completely peptonized.

Pigment.—None.

Growth.—Rapid.

Oxygen conditions.—Oxygen is required for growth.

Odor.—An old musty odor.

Acids.—No acid is produced even in the presence of lactose or glucose.

Behavior to gelatin.—Liquefies very rapidly.

No. 48.

Source.—This micro-organism was found in sample of Pasteurized milk marked *L.*

Form and grouping.—A bacillus whose thickness varies from ⅓ m to ½ m, and whose length varies from ⅚ m to 1¾ m. It is found single and in pairs.

Spores.—No spores have been observed.

Protoplasm.—The protoplasm seemed granular in old cultures.

Motion.—No decided motion could be discerned; Brownian motion was present.

Staining reaction.—Stains readily with ordinary aniline stains.

Temperature.—Its optimum temperature is 30° C.–32° C., but below 22° C. it grows very slowly. It remains alive at 80° C. for 20 min., but is killed at 85° C. for the same time.

Colonies.—The colonies at first appear as little dots which are crystalline and bright and have a very well defined border. Later there extends from this border a thin plaque over the surface of the gelatin. It is of almost transparent lightness and is crystalline as the original colony. There is a distinct and even border to this plaque. The colony as a whole has a yellowish tinge.

Gelatin tube-cultures.—The growth extends along the line of puncture, but is heavier at the surface than deep in the tube; yet a heavy growth develops along the entire line of puncture, and there is no liquefaction whatever.

Agar inclined tube-cultures.—Is confined to the streak. It does not form a heavy growth and its color is a light lemon yellow.

Bouillon cultures.—There is an evenly clouded appearance which does not clear. At the bottom is a granular sediment, and at the surface no scum forms.

Milk cultures.—The milk is unchanged in appearance and is acid.

Potato tube-culture.—A lemon yellow growth spreads over the surface of the potato but is not exuberant.

Blood serum-culture.—No change in the serum is apparent.

Growth.—Rapid.

Pigment.—A lemon yellow pigment is produced.

Oxygen conditions.—Grows better in the presence of oxygen and will grow well under anaërobic conditions.

Odor.—No marked odor.

Acids.—Traces of acids produced in the presence of lactose.

Behavior to gelatin.—Gelatin is not liquefied.

No. 60.

Source.—Sample of Pasteurized milk O.

Form and grouping.—Bacillus whose thickness varies from ⅓ m to ½ m and whose length from 1 m to 2 m. The ends are square. They are usually found in short threads.

Spores.—No spores observed.

Protoplasm.—The protoplasm soon becomes granular. Whether this has any significance in the formation of spores we are unable to say.

Motion.—Only Brownian motion present.

Staining reaction.—Stains readily with the ordinary aniline stains.

Temperature.—Its optimum temperature is 25° C.–30° C., and it grows very slowly below 20° C. 80° C. for 20 min. does not kill, but it succumbs to 85° C. for the same time.

Colonies.—It grows into a colony which is brownish yellow and granular. The borders are regular and sharp. Round in shape and well defined and abrupt borders give the colonies a globular appearance. The colony rests upon and rises above the surface of the gelatin. No sinking or growing into the gelatin occurs.

Gelatin tube cultures.—The growth extends along the line of inoculation in a heavy line without any liquefaction of the gelatin.

Agar inclined tube-cultures.—A moist growth of a creamy consistency follows the line of inoculation upon the surface of the agar. Patches of a denser and whiter growth are found upon the surface of the other growth.

Bouillon cultures.—A very light scum forms on the surface. The liquid remains cloudy and a sediment is found at the bottom of the tube.

Milk cultures.—The milk is curdled only.

Potato tube-cultures.—A slight white and mealy growth appears scattered over the surface of the potato in small patches.

Growth.—Grows very slowly.

Pigment.—There is a perceptible yellowish tinge.

Oxygen conditions.—Grows more readily in the presence of oxygen.

Odor.—No odor.

Acids,—Produces an acid in the presence of lactose.

Behavior to gelatin.—There is no liquefaction.

No. 62.

Source.—Taken from Pasteurized sample Z.

Form and grouping.—Bacillus. Its thickness varies from 1 m to 1½ m in thickness, and from 2 m to 3 m in length. Its ends are tapering. It is found single but sometimes in pairs.

Spores.—No spores were observed.

Protoplasm.—The protoplasm is homogeneous.

Motion.—It is not actively motile, but when moving its motion is of a tumbling nature.

Staining reaction.—The ordinary aniline stains act readily.

Temperature.—The optimum temperature is placed at 28° C.-32° C., and it grows very slowly below 20°C. 70°C for 20 min. does not kill it, but 75°C for the same time does.

Colonies.—The colonies are bright and glistening, with borders regular and abrupt. The color is yellowish, yet it is changeable to the different reflections. The center is usually lighter than the border. No liquefaction takes place.

Gelatin tube-cultures.—A white growth appears along the line of inoculation and does not spread over the surface.

Agar inclined tubes.—The growth is hardly perceptible; what is seen is scattered over the surface in very small and scanty patches.

Bouillon cultures.—A very fine cloudiness pervades the liquid. There is no scum on the surface and no sediment on the bottom.

Milk cultures.—No change observed.

Potato tube-cultures.—There is no visible growth.

Growth.—Very slow.

Pigment.—No pigment.

Oxygen conditions.—Grows anaërobically and aërobically.

Odor.—No odor.

Acids.—Simply a slight trace of acid formation in the presence of lactose.

Behavior to gelatin.—No liquefaction.

No. 107.

Source.—Taken from changed Pasteurized milk F.

Form and grouping.—Bacillus, the thickness of which varies from 1¼ m to 1⅜ m, and the length of which varies from 3 m to 8 m. It is found single and in short threads.

Spores.—Median spores are formed in old cultures, especially on agar.

Protoplasm.—The protoplasm is granular.

Motion.—The motion is progressive but not rapid.

Staining reaction.—It reacts to the ordinary aniline stains very readily.

Temperature.—The optimum temperature is 25° C.–30° C. At 93° C. it remains alive for 20 min., but is killed at 96°C for the same time. Scarcely grows below 20°C.

Colonies.—They appear as little dark round spots at first, which send out from their border filaments, lash like, and which grow through the solid gelatin without any liquefaction. After increasing in size they liquefy quite rapidly, but the colony does not change in general appearances.

Gelatin tube-cultures.—The growth is along the entire line of inoculation, growing better at the surface than deep in the tube. After the growth has become quite heavy along the line of inoculation a number of short stubby processes are given off and the entire growth resembles a pine tree with its limbs cut off six inches from the trunk. Developing still further, the gelatin begins to liquefy and there is a long narrow funnel produced.

Agar inclined tube-cultures.—There is a spreading, raised, wrinkled growth over the surface. The borders are irregular and somewhat crystalline.

Bouillon cultures.—There is a heavy growth, most of which settles in the bottom. Some masses are left suspended in the liquid and the bouillon does not clear readily.

Milk cultures.—The casein is curdled, then peptonized completely and the liquid is dark in color.

Potato tube-cultures.—A grayish white mealy growth spreads over the surface of the potato.

Blood serum cultures.—Serum is completely peptonized.

Growth.—Comparatively slow.

Pigment.—None.

Oxygen conditions.—Grows better in presence of oxygen, but will grow without it.

Odor.—No characteristic odor.

Acids.—Acid is produced in presence of lactose but not without it.

Behavior to gelatin.—Liquefies gelatin.

No. 112.

Source.—Taken from changed Pasteurized milk *G.*

Form and grouping.—Bacillus. Its thickness varies from 1 m to 1½ m and its length 4 m to 12 m. The bacilli are found single and in short threads.

Spores.—Median spores are formed in old cultures on agar.

Protoplasm and cell-wall.—The protoplasm is somewhat granular and the cell-wall shows distinct markings between the cells when formed in threads.

Motion.—Sluggish and serpentine.

Staining reaction.—Stains readily with the ordinary aniline stains.

Temperature.—It grows best at 26° C.–30° C. Below 15° C. there is no growth at all. 70° C. for one hour does not kill it but 75° C. for 20 min. does.

Colonies.—The center of the colony is dark and without definition, appearing as if made up of a bunch of threads. Its border is ill defined and from it proceed many fine filaments and some heavy lash-like processes. At times the lash-like processes resemble a string of beads.

Gelatin tube-cultures.—There is only a small growth deep in the tube along the line of inoculation; at the surface a shallow cup soon forms from liquefaction and this continues to deepen and widen until a long wide funnel is made and eventually all the gelatin is liquefied.

Agar inclined tube-cultures.—Along the streak forms a series of oval colonies; those at the bottom of the streak are much larger than those at the top. The growth is moist and grayish white.

Bouillon cultures.—Little patches of granular growth are found on the surface. The cloudiness appears granular and is very persistent, only a slight sediment forming on the bottom.

Milk cultures.—The milk loppers and acts much like ordinary souring.

Blood serum cultures.—Heavy white growth on the surface, but it is not peptonized.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Requires oxygen for its development.

Odor.—No odor.

Acids.—Acid is produced in the presence of lactose, but in its absence there is none formed.

Behavior to gelatin.—Liquefies readily.

No. 115.

Source.—Taken from soured Pasteurized milk *I.*

Form and grouping.—Bacillus, the thickness of which varies from 1¼ m to 2 m, and the length from 3 m to 12 m. It is found single and in pairs, sometimes in short threads. The ends are round.

Spores.—Median spores are formed which seem considerably smaller in diameter than the thickness of the cell.

Protoplasm and cell-wall.—It possesses a granular protoplasm. The cell divisions are very distinct.

Motion.—There is a progressive serpentine motion.

Temperature.—Its optimum is 28° C.–32° C. Does not grow below 15° C. It withstands 80° C. for 20 min., but is killed at 85° C. for the same time.

Colonies.—The colonies have a very dark center from which radiate lash-like filaments. As it continues to grow, there are fine processes proceeding from the center also filling in the spaces between the lash-like processes. The latter resemble the "ray crown" somewhat. However the large limbs bar out the perfect "ray crown." Liquefaction begins soon after the fine processes start.

Gelatin tube-cultures.—The growth is along the line of inoculation, developing deep in the tube as well as at the surface. Liquefaction soon begins and it takes place as fast in the lower portion of the tube as at the upper. This continues till all the gelatin is liquefied.

Agar inclined tube-cultures.—A heavy, moist and wrinkled growth spreads over the surface. The borders are irregular.

Bouillon cultures.—No growth on the surface. The cloudiness has a somewhat granular appearance. Sediment is found at the bottom.

Milk cultures.—The milk is peptonized very rapidly and is of a dark color.

Potato tube-cultures.—A dirty white and uneven growth spreads over the surface of the potato.

Growth.—Rapid.

Pigment.—None.

Oxygen conditions.—Will grow without free oxygen.

Acids.—No acid produced even in the presence of lactose and glucose.

Behavior to gelatin.—Liquefies gelatin rapidly.

No. 116.

Source.—Taken from soured Pasteurized milk *J.*

Form and grouping.—Bacillus. Its thickness varies from 1¼ m to 2½ m, and its length from 2⅓ m to 6⅔ m. This bacillus forms in short threads. Involution forms are very common in old cultures.

Spores.—Median spores are formed.

Protoplasm.—The protoplasm is homogeneous.

Motion.—It has progressive motion, snake like.

Staining reaction.—Aniline stains react readily.

Temperature.—The optimum temperature varies from 22° C.–28° C. Grows very slowly below 15°. It withstands 85° C. for 20 min., but is killed at 90° C. for the same time.

Colonies.—They begin as light brown spots with well defined borders. Soon fine filaments are seen to proceed from the border and reach out into the gelatin. After a time these filaments become numerous and completely enshroud the body of the colony. The border, however, remains distinct throughout these filamentous changes. The colonies liquefy the gelatin over slowly.

Gelatin tube-cultures.—The growth is along the entire line of puncture but more abundant at the surface. Liquefaction begins at the upper portion and gives rise to a broad, shallow cup, at the lower portion of which the liquefaction continues along the puncture to the bottom of the tube in a narrow funnel. From this stage the liquefaction continues until the entire gelatin is liquefied.

Agar inclined tube-cultures.—A moist, heavy and wrinkled growth spreads over the surface of the gelatin. The color is a brownish white.

Bouillon cultures.—No growth is formed on the surface. The cloudy liquid, instead of clearing, remains impregnated with a flocculent substance. At the bottom is a sediment.

Milk cultures.—The milk is rapidly peptonized. Instead of leaving a clear fluid, it is filled with a flocculent substance.

Potato tube-cultures.—A moist grayish white growth appears which dries down into a mealy mass.
Growth.—Rapid.
Pigment.—None.
Oxygen conditions.—It will grow without the presence of free oxygen, but the growth is somewhat restrained.
Odor.—A disagreeble odor.
Acids.—No acids produced in any of the cultures, even in the presence of loctose or glucose.
Behavior to gelatin.—Liquefies.

No. 117.

Source.—Taken from changed Pasteurized milk *L.*
Form and grouping.—Bacillus. Its length varies from 1 m to 1¾ m, and its length from 3 m to 9 m. It is found single and in threads of different lengths. The ends are round.
Spores.—Median spores are developed.
Protoplasm.—The protoplasm is granular.
Motion.—It has a progressive serpentine motion.
Staining reaction.—Ordinary aniline stains react readily.
Temperature.—Its optimum temperature is 25° C.-30° C. It is not killed at 80° C. for 20 min., but is killed at 85° for the same time. Develops very slowly below 16° C.
Colonies.—The body of the colony is light brown and the border is irregular. From the border radiate fine filaments which form a dense net work about the colony.
Gelatin tube-cultures.—The growth is along the entire line of inoculation; the growth is as heavy at the bottom as at the top. In liquefying the funnel formed has straight sides and reaches nearly to the bottom of the tube. The gelatin is gradually liquefied.
Agar inclined tube-cultures.—A heavy, moist and wrinkled growth spreads over the surface of the agar, the border of which is serrated.
Bouillon cultures—A greasy thin growth forms on the surface. The cloudiness is evenly distributed and some sediment may be found at the bottom.
Milk cultures.—The milk is first loppered, then peptonized.
Potato tube-culture.—
Blood serum-culture.—Serum is completely peptonized.
Growth.—Rapid.
Pigment.—None.
Oxygen conditions.—Grows anaërobically as well as aërobically.
Odor.—
Acids.—Acid is produced in the presence of lactose.
Behavior to gelatin.—Liquefies.

After reviewing the histories and bearing in mind the appearances of these bacteria, it seems possible that numbers 30, 32, 43, 45, 46 might be a single species, notwithstanding marked differential features when growing side by side under the same conditions. This too may be said of 107, 112, and 115; also of 116 and 117. This may be true of other combinations. This, however, is a study by itself and months of work may not reveal any satisfactory results, if we are to judge from the time and work put upon the differentation of Eberth's bacillus and the Colon bacillus or bacilli. Although we are unable to make a satisfactory statement in regard to species, we hope that this phase of the work will not detract from the value of the remainder.

2. Determining the Source of Such Bacteria.

No exhaustive work has been pursued in this connection. Our purpose was simply to ascertain where these resistant bacteria may have their source or where they may be found before reaching the milk.

Numerous plates were made from the dust floating in the air of the stable, from the particles of filth falling from the nether regions of a cow and her udder, and from the milk house or dairy. By means of the apparatus described in Bulletin 140, p. 101, the milk from the milk duct was studied.

After the plates made from these different sources had developed, the colonies were studied closely and bouillon cultures made from the different kinds. These were subjected to the stated Pasteurization after they had grown for several days, and two or three days after Pasteurizing, transplantations were made into sterile bouillon tubes, using three platinum loopfuls for each inoculation. If any of these latter tubes developed, they were regarded as bacteria resistant to Pasteurization.

This work may be tabulated as follows:

In the dust from the stable, 2 were found out of 20.

In the dirt from the cow, 2 were found out of 24.

In the dust from the dairy, 1 was found out of 15.

In the fore milk of the milk-duct, 3 were found out of 25.

From this we may expect to find resistant bacteria in the dust of the stable, in the filth from the cow, in the dust of the dairy and in the milk-duct of the teat; in fact, we may expect them from almost any source to which the milk is exposed.

3. The Study of Their Actions Upon Milk.

What the bacteria may do when left after Pasteurizing is interesting, because it has been supposed that the lactic acid bacteria have been killed. This is largely true but not universally. The keeping quality of the milk is only slightly enhanced, and yet the changes which follow Pasteurization are markedly different. Normally, milk sours from the growth of the lactic acid bacteria, but when these bacteria are killed other varieties act and most of these may be said to peptonize or digest the casein of the milk, making the milk as clear as water. This digestion is simply the conversion of the insoluble casein into the soluble form caseon. Before this digestion, in some cases, the milk is curdled by a ferment secreted by the bacteria. Again, the milk is curdled by acid formation without any digestion, as in the usual lactic acid fermentation. A few bacteria are found which produce no change whatever to the naked eye.

The following tables will illustrate the different actions of the species isolated:

+ = Affirmative.
— = Negative.

Those bacteria which curdle the milk only.

3	6	9	29	30	32	38	43	44	45	46	48	60	62	107	112	115	116	117
—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	+	—	—	—

Those bacteria which peptonize or digest the casein.

3	6	9	29	30	33	38	43	44	45	46	48	60	62	107	112	115	116	117
+	+	+	—	+	+	+	+	+	+	+	—	—	—	+	—	+	+	+

Those bacteria which curdle then peptonize the casein.

3	6	9	29	30	32	38	43	44	45	46	48	60	62	107	112	115	116	117
+	+	+	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+

Those bacteria which produce an acid.

3	6	9	29	30	32	38	43	44	45	46	48	60	62	107	112	115	116	117
—	—	—	+	—	—	—	—	—	—	—	+	+	+	+	+	—	—	+

Those bacteria which produce no perceptible change in milk.

3	6	9	29	30	32	38	43	44	45	46	48	60	62	107	112	115	116	117
—	—	—	+	—	—	—	—	—	—	—	+	—	+	—	—	—	—	—

4. THE INVESTIGATION OF THE THERMAL DEATH-POINTS OF THE SPECIES ISOLATED.

It is generally recognized that there are always left after Pasteurization many resistant bacteria, and it has been suggested that by a moderate elevation of the temperature, these might be killed.

From a perusal of the thermal-death-points of the species isolated, it will be easily seen that a slight elevation of temperature would have little effect and that the temperature employed was sufficiently high to accomplish its purpose, if the pathogenic bacteria were also killed.

A special experiment was made with the tubercle bacillus. Tuberculous material was taken from an animal affected with tuberculosis, and was thoroughly mixed in milk. Part of the milk so treated was heated at 68° C. for 20 minutes, then injected into guinea pigs, 3 in number; the other part was injected into a guinea pig without heating. The three pigs did not contract tuberculosis while the one did. This experiment will be reported in a bulletin on tuberculosis, but this is sufficient to show that the heating at 68° C. for 20 minutes was fatal to the bacillus. [*This must not be considered conclusive. Author.*]

The following table will illustrate the resistance of the bacteria isolated from Pasteurized milk.

The temperatures are centigrade and the marks, plus denotes resistance to the temperature and minus denotes killed at the temperature.

No. of micro-organisms.	70° for 20 min.	70° for 30 min.	70° for 1 hour.	75° for 20 min.	80° for 20 min.	85° for 20 min.	90° for 20 min.	90° for 20 min.	93° for 20 min.	96° for 20 min.	100° for 20 min.
3	+	+	+	+	+	+	+	+	+	−	−
6	+	+	+	+	+	+	+	+	+	+	−
9	+	+	+	+	+	+	+	+	−	−	−
29	+	+	+	+	+	−	−	−	−	−	−
30	+	+	+	+	+	−	−	−	−	−	−
32	+	+	+	+	+	+	−	−	−	−	−
38	+	+	+	+	+	+	−	−	−	−	−
43	+	+	+	+	+	+	+	+	+	−	−
44	+	+	+	+	+	−	−	−	−	−	−
45	+	+	+	+	+	+	−	−	−	−	−
46	+	+	+	+	+	+	+	+	+	−	−
48	+	+	+	+	+	−	−	−	−	−	−
60	+	+	+	+	+	−	−	−	−	−	−
62	+	+	+	−	−	−	−	−	−	−	−
107	+	+	+	+	+	+	+	+	+	−	−
112	+	+	+	−	−	−	−	−	−	−	−
115	+	+	+	+	+	−	−	−	−	−	−
116	+	+	+	+	+	+	−	−	−	−	−
117	+	+	+	+	+	−	−	−	−	−	−

5. THE EFFECT OF SUDDEN COOLING AFTER PASTEURIZATION UPON THE SPECIES ISOLATED.

It has been stated by certain writers that sudden cooling was essential to stun the bacteria. Others say that if the cooling is rapid enough to stay the multiplication of bacteria, that is all that is required. To gain the real value of sudden cooling upon the milk bacteria isolated, the author selected six varieties showing the widest differences for this test.

Bouillon cultures were made and allowed to stand a few days for spore formation, then they were subjected to Pasteurization. After Pasteurization, one tube of each species was cooled suddenly to 8° C. [46° F.] and one tube was allowed to cool to the temperature of the room gradually. As soon as each had reached its desired temperature, fresh sterile bouillon was inoculated, one tube from each and three platinum loopfuls for each tube. They were placed away side by side at room temperature for development. When there were the first traces of growth, the time was noted. Five tests of each variety were made in this manner and the results noted as in the following table:

No. of micro-organisms.	First test.				Second test.				Third test.				Fourth test.				Fifth test.			
	Cultures,* Hours.	Controls,† Hours.	Cooled ‡ Hours.	Non-cooled.‖ Hours	Cultures, Hours.	Controls, Hours.	Cooled. Hours.	Non-cooled. Hours.	Cultures, Hours.	Controls, Hours.	Cooled. Hours.	Non-cooled. Hours.	Cultures, Hours.	Controls, Hours.	Cooled. Hours.	Non-cooled. Hours.	Cultures, Hours.	Controls, Hours.	Cooled. Hours.	Non-cooled. Hours.
3	48	33	67	75	95	28	48	67	117	24	54	46	140	29	45	45	164	21	46	46
21	48	25	51	57	95	20	29	48	117	24	31	26	140	24	28	45	164	7	29	30
30	48	33	58	67	95	20	68	53	117	26	46	31	140	24	45	45	164	6	29	29
48	48	46	95	100	95	53	68	76	117	46	56	54	140	45	94	70	164	46	119	94
107	48	25	43	51	95	20	----	----	117	24	31	32	140	24	29	29	164	7	29	29
116	48	25	47	93	95	22	53	28	117	24	31	26	140	24	45	29	164	7	46	29

* Cultures—refers to the age of the culture used in Pasteurization.
† Controls—cultures made at the same time as those Pasteurized but put away for development.
‡ Cooled—cultures Pasteurized and suddenly cooled.
‖ Non-cooled—cultures Pasteurized and allowed to cool gradually.

In this work 10 cultures of the suddenly cooled exceeded the time of development of the non-cooled; 12 cultures of the non-cooled or cooled gradually, exceeded the time of development of the cooled; 6 cultures of the suddenly cooled developed in the same time as the non-cooled. Sudden cooling seems to have no effect on the time of development.

6. THE RESTRAINING INFLUENCE OF COLD UPON THE SPECIES ISOLATED.

Cold always retards the development of bacteria. This is clearly shown upon the species in question by the table below:

No. of micro-organisms.	First test.				Second test.				Third test.				Fourth test.				Fifth test.			
	Cultures.* Days.	Controls.† Days.	Cooled.‡ Days.	Non-cooled.‖ Days.	Cultures. Days.	Controls. Days.	Cooled. Days.	Non-cooled. Days.	Cultures. Days.	Controls. Days.	Cooled. Days.	Non-cooled. Days.	Cultures. Days.	Controls. Days.	Cooled. Days.	Non-cooled. Days.	Cultures. Days.	Controls. Days.	Cooled. Days,	Non-cooled. Days.
3	6	25	38	----	7	----	----	----	3	17	----	----	4	26	----	----	5	----	----	----
21	6	14	45	45	7	25	----	----	3	43	2 7	----	4	42	----	----	5	22	----	----
30	6	----	45	----	7	----	----	----	3	----	----	----	4	----	----	----	5	----	----	----
48	6	8	19	21	7	15	25	25	3	----	24	----	4	13	23	42	5	17	27	25
107	6	----	----	----	7	----	----	----	3	----	----	----	4	----	----	----	5	----	----	----
116	6	26	28	----	7	----	----	----	3	27	----	----	4	42	----	----	5	22	41	----

* Cultures—age of cultures when Pasteurized.

† Controls—cultures made at the same time as those Pasteurized, but placed at room temperature instead of refrigerator temperature.

‡ Cooled—cultures Pasteurized, suddenly cooled and placed in the refrigerator at 15° C.

‖ Non-cooled—cultures Pasteurized, gradually cooled and placed in the refrigerator at 15° C.

The blank spaces indicate no growth after 45 days.

Sudden cooling apparently had no effect in the case of refrigerator temperature 15° C. [59° F.], but the constant cool temperature retarded greatly the growth of these micro-organisms.

To make this thoroughly applicable, six miscellaneous micro-organisms were treated in the same way as the previous set but were not subjected to Pasteurization. Here it will be noticed that the time of development is much less, but the refrigerator temperature retarded the growth by several days. The table will explain itself.

No. of micro-organisms.	First test.		Second test.		Third test.		Fourth test.		Fifth test.	
	Controls.*	Refrigerator cultures.†	Controls.	Refrigerator cultures.	Controls.	Refrigerator cultures.	Controls.	Refrigerator cultures.	Controls.	Refrigerator cultures.
126	1	4	1	4	1	3	1	4	1	3
128	1	4	1	4	1	3	1	4	1	3
129	1	3	1	3	1	2	1	2	1	3
134	1	3	1	3	1	2	1	2	1	3
136	1	8	1	7	1	5	1	4	1	6
138	1	4	1	4	1	2	1	2	1	3

* *Controls* kept at temperature of room.

† *Refrigerator cultures*—those inoculated then placed in refrigerator.

7. THE RESTRAINING INFLUENCE OF HEAT UPON THE SPECIES ISOLATED.

This subject has been repeatedly illustrated, yet it may be profitable to append a table illustrating this point. The method was identical with that employed under No. 5 and in fact was a part of it; that is, bouillon tubes were inoculated from cultures, one set was Pasteurized and the other set untouched. From these sets fresh bouillon tubes were inoculated and the time of development was recorded in the following table:

No. of micro-organisms.	First test.		Second test.		Third test.		Fourth test.		Fifth test.	
	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures unheated. Hours.	Cultures heated. Hours.
3	33	75	28	67	24	46	29	45	21	46
21	25	57	20	48	24	26	24	45	7	30
30	33	67	28	53	26	31	24	45	6	29
48	46	100	53	76	46	54	45	70	46	94
107	25	51	20	--------	24	32	24	29	7	29
116	25	93	22	28	24	26	24	29	7	29

8. THE RESTRAINING INFLUENCE OF HEAT FOLLOWED BY A LOW TEMPERATURE UPON THE SPECIES ISOLATED.

There is little difference between Nos. 7 and 8; yet there may be considerable importance attached to the following of Pasteurization by a low degree of temperature. It is asserted that bacteria in the spore form require a higher degree of temperature for development than when in the vegetative form. Of the bacteria isolated, the following table will state whether spores were observed. Plus is affirmative and minus negative.

No. of micro-organisms:—

3	6	9	29	30	32	38	43	44	45	46	48	60
+	+	+	—	+	+	+	+	+	+	+	—	—
62	107	112	115	116	117							
—	+	+	+	+	+							

This table is by no means conclusive, for those in which the spores were not observed may, under conditions not studied, produce spores. Careful attention was given to the formation of spores.

Now we are ready to give our table illustrating the restraining influence of heat followed by a continuous low temperature. Bouillon tubes were used as in previous cases because of the easy recognition of development. We have shown that heat restrains the growth considerably even when placed in favorable temperature for development. It appears to me that by contrasting this table with the table illustrating the time of development in the refrigerator, we shall have gained the desired knowledge. Blank spaces had not developed in 45 days.

No. of micro-organisms.	First test.			Second test.			Third test.			Fourth test.			Fifth test.		
	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures heated and refrigerator. Days.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures heated and refrigerator. Days.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures heated and refrigerator. Days.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures heated and refrigerator. Days.	Cultures unheated. Hours.	Cultures heated. Hours.	Cultures heated and refrigerator. Days.
3	33	75	------	28	67	------	24	46	------	29	45	------	21	46	------
21	25	57	45	20	48	------	24	26	------	24	45	------	7	30	------
30	33	67	------	20	53	------	26	31	------	24	45	------	6	29	------
48	46	100	21	53	76	25	46	54	------	45	70	42	46	94	25
107	25	51	------	20	------	------	24	32	------	24	29	------	7	29	------
116	25	93	------	22	28	------	24	26	------	24	29	------	7	29	------

9. SUGGESTIONS AS TO THE REDUCTION OF INFECTION.

Owing to the fact that these resistant bacteria are found in the milk ducts, in the filth of the barn and in the dairy, I can only advise the general recommendations made in the bulletin preceding this. In successful dairying, cleanliness must be observed.

10. THE VALUE OF PASTEURIZATION.

Pasteurization has for its objects, the reduction of the number of bacteria, the enhancing of the keeping quality, and the killing or devitalizing of pathogenic bacteria.

It is true that the number of bacteria is considerably reduced; but the reduction in the number of harmless bacteria cannot be a practical gain especially when these bacteria (lactic acid bacteria) are more desirable than those that remain. The lactic acid bacteria check the growth of other bacteria by the formation of acid. If those bacteria remaining after Pasteurization (mostly peptonizing bacteria) are allowed to grow for a sufficiently long time, they may produce substances which are not only detrimental many times to the animal economy but even poisonous. Guinea pigs have been poisoned with the products of these bacteria. A single experiment will illustrate this point. A culture of one of the peptonizing bacteria in milk was taken after the milk had been completely peptonized and made slightly acid with acetic acid. It was filtered and evaporated to a syrupy mass, when it was extracted with alcohol and the alcohol extract evaporated to dryness. The residue was dissolved in the least possible amount of distilled water. One cubic centimeter of this solution killed a guinea pig in a few hours.

The enhancing of the keeping qualities is not great enough to warrant Pasteurization; for even Pasteurized milk must be used within two or three days to be fresh and palatable. Ordinary milk will keep as long as this, when placed upon ice the same as Pasteurized milk.

The whole value of Pasteurized milk lies in its absence from danger of pathogenic [disease-producing] bacteria. This is, however, important enough to warrant its use, both on account of the prevalence of tuberculosis and typhoid fever. Too much stress cannot be placed upon it in the preparation of milk for children. Intestinal disorders are so common with them and so many disorders are attributable to bacteria that every precaution should be observed. For the Pasteurizing of milk in small quantities, I know of no better apparatus than that of Dr. DeSchweinitz, described in Bulletin 134, p. 33, of this station.

I wish to acknowledge my appreciation for the valuable suggestions of Prof. C. D. Smith and Mr. G. H. True and also to state that Mr. G. H. True Pasteurized all of the samples used.

STRAWBERRIES.

L. R. TAFT AND H. P. GLADDEN.

Bulletin 148.—Horticultural Department.

The season of 1896 was very favorable for plant growth and most varieties were in good condition to bear a large crop of fruit last spring. The season of 1897 was two weeks later than that of the previous year, and the plants which had been held back by the cold spells came into bloom very quickly, and so many blossoms came out that the plants were not able to produce sufficient pollen to properly fertilize all the fruits. Many staminate sorts appeared almost imperfect in flower. Doubtless, the small crop borne by some sorts and the great number of imperfect berries was due to the excessive blossoming. The difference between the time of ripening of the early and late sorts was not so great as usual. When the season opened all varieties came on together.

The table (page 238) was compiled from plants set in 1896. Each variety was given forty feet of space in the row; in one-half of this distance the plants were grown in hills (thirteen); in the other portion the plants were allowed to form a matted row. In nearly every case the largest yield was obtained from the matted rows.

The following sorts fruited here for the first time during the past season:

Anna Kennedy.—Received from J. T. Lovett Co., Little Silver, N. J. Imperfect flower. The variety is fairly vigorous in plant growth, with bright, healthy foliage. The berries are of good size, very regular in form and they have a bright, glossy appearance that makes them attractive for market. In quality it ranks high and seems to possess the necessary firmness to hold up well. The plants retain their vigor to close of season and the last fruits are of good size and form. Were the variety more productive it would find a place as one of the better sorts for market or home use.

Annie Laurie.—From Matthew Crawford, Cuyahoga Falls, Ohio. Perfect flower. The plants are of low, stocky growth, and seem somewhat subject to blight. The berries are usually large, round conical in form and of a bright, glossy scarlet color. In quality and firmness of fruit the variety ranks very high, but seems to lack the plant qualities necessary to produce a large crop of berries.

STRAWBERRIES—TABLE OF VARIETIES.

ABBREVIATIONS.

Form.		Size.	Sex.	Color.	
b broad.	l long.	s small.	p pistillate or imperfect.	b bright.	l light.
c conical.	o oval.	m medium.	b bisexual or perfect.	c crimson.	r red.
d depressed.	r round.	l large.		d dark.	s scarlet.
i irregular.					

Variety.	Sex.	Vigor (1 to 10.)	Date of bloom.	First ripe fruits.	Last fruits.	Productiveness.	Size.	Form.	Color.	Quality.	Firmness.
Acme	b	9.8	May 28	June 18	June 25	7	s	r c	l s	9	8
Allen No. 3	p b	8.8	" 23	" 19	" 25	8	l	r c	b c	9	8.5
Anna Kennedy	p	9.2	" 24	" 19	" 25	8.5	m to l	r c	b s	9	9
Annie Laurie	b	9	" 25	" 20	" 30	7	m to l	r c	b s	9.8	9.5
Apache	b p	10	" 19	" 14	July 5	9.2	m	l c	l s	5	8
Aroma	b	9.4	" 22	" 18	" 5	8.4	l	l c	l s	8	9.5
Arrow	p	9	" 18	" 14	" 2	9.3	m to l	l c	v d c	9.5	8.5
Beauty	b	8.5	" 22	" 16	June 30	9	l	r b c	b d s	8.5	8
Beder Wood	b	8.5	" 17	" 12	" 30	9	m	r	l c	8	8.5
Beebe	p	8.2	" 19	" 17	" 30	7	m to l	r c	c	9	8.5
Belle	b	8.8	" 22	" 20	" 25	7	m to l	l c	b s	8	9
Belle of Lacrosse	p	7	" 23	" 17	" 25	8	l	r b c	b d s	8	8
Bird	p	9.3	" 23	" 17	" 30	9	l	l c	b d s	9	9.2
Bisel	b	9	" 19	" 17	" 30	8.5	m	l b	b c	9	9
Bixler	b	9.2	" 21	" 16	" 25	7	s to m	r d c	l s	9.5	8.5
Blonde	b	9	" 25	" 19	" 30	7	m	r c	l r	8	7.5
Bostonian	b	9.3	" 24	" 18	" 30	6.5	m to l	r c	b s	9.8	9
Bouncer	b	8	" 22	" 19	" 25	5	m	l c	v d c	8	8.5
Brandywine	b	9.6	" 22	" 19	July 5	8.2	l	r c	b d c	9.5	8.5
Brooke	p	8.5	" 25	" 19	June 29	8	l	b d c	d c	9.5	8.5
Brunette	b	9.4	" 24	" 19	" 30	8.5	l	r c	d c	9.8	9
Bubach	p	9.6	" 24	" 19	" 30	8.5	l	d c	l c	9	8
Champion	b	8.2	" 19	" 19	July 2	8	l	l c	d s	8	7
Charlie	p	9.3	" 21	" 17	" 2	8.5	m	l c	b d s	9	8.8
Cherokee	b	9.5	" 19	" 15	June 30	8.5	m	r c	c	9	8.5
Childs	b	8	" 17	" 14	" 29	8	l	d c	b c	9.5	9
Clyde	b	9.5	" 17	" 12	" 25	8.5	l	r c	l s	9	8.5
Columbian	b	9.2	" 21	" 17	" 25	8.5	l	r c	b s	8.5	8.5
Cruse No. 9	p	5	" 23	" 21	" 28	6	m	r c	l r	7	7
Cyclone	b	9	" 17	" 16	" 25	8.5	m	l c	d c	9	9
Dakota	b	9.2	" 22	" 17	" 30	9	m to l	l c	b s	9	7
Dictator	p	8	" 17	" 12	" 30	8	m	r c	r	7.5	8.5
Earliest	b	9.5	" 15	" 14	" 25	6	m to l	r c	l s	7.5	7
Early Bird	b	8	" 21	" 16	" 25	7	s	i	l c	7.5	8
Early Jack	b	9	" 16	" 12	" 28	6	s to m	i	b s	7	7
Edith	p	7.5	" 29	" 22	July 5	7	m	l b c	d c	9	9.5
Edward Favorite	b	4	" 22	" 19	June 25	2	l	r c	b d c	9.4	9
Enormous	p	9.2	" 25	" 19	July 2	9	l	i	d c	9	9
Epping	p	9.4	" 24	" 15	June 29	8	l	r d c	l s	8	9
Equinox	b	8	" 21	" 19	July 2	7	s	d c	c	8	8.5
Eureka	p	9.6	" 22	" 17	" 5	9.2	l	r c	d c	7	8
Farmington	b	8.8	" 23	" 16	June 30	8.8	l	r c	d s	9.4	9
Fremont	b	9.8	" 21	" 19	" 30	9.5	m to l	l c	b s	9	8.8
Gandy	b	9	" 25	" 21	July 5	8	l	b c	l c	8.5	8.5
Gen. Fifer	b p	8.8	" 22	" 18	" 2	8.5	m	r c	b r	9	9
Gertrude	b	9	" 17	" 15	June 25	5	l	b c	l s	8	8.5
Giant	b	8.8	" 18	" 12	July 2	8.5	l	r c	b c	9.8	9.5
Glen Mary	b	8.5	" 20	" 16	June 30	8.5	l	c	b s	9	9
Graham	b	7.8	" 24	" 19	" 25	6	s	r c	d c	9.2	8
Granville	b	8.8	" 21	" 18	July 5	7	l	r d c	d c	9	8

STRAWBERRIES.—CONTINUED.

Variety.	Sex.	Vigor (1 to 10).	Date of bloom.	First ripe fruits.	Last fruits.	Productiveness.	Size.	Form.	Color.	Quality.	Firmness.
Greenville	p	9.4	May 22	June 18	June 30	8.5	l	r d c	b c	8.5	7.5
Haverland	p	9.7	" 24	" 17	" 29	9	m	l c	s	8.5	8.5
Hayes	p	5	" 24	" 17	" 29	5	m	d c	d c	8	8.5
Hersey	b	8.8	" 20	" 16	" 25	7	m	r c	c	8.5	8.5
Holland	p	9	" 23	" 18	" 30	7	m	l b c	d c	9	9
Homestead	b	8.5	" 22	" 17	" 30	5	s	i	r c	9.8	7
Hull No. 3	b	8.2	" 23	" 20	" 25	6	l	d c	l s	9	7
Huntsman	b	8.8	" 21	" 12	" 25	7	m	r c	l c	8	8.5
Ideal	b	9	" 22	" 17	" 25	8.5	m to l	r c	b c	9	9
Iowa Beauty	b	9.2	" 22	" 15	" 30	8	m	r c	d c	9.5	8.5
Jarbalo	p	9.1	" 22	" 17	" 29	8	m to l	r c	d c	7.5	8.5
Jay Gould	p	9.2	" 22	" 17	" 25	7.5	m	r c	b c	9.2	9
Jerry Rusk	b	8	" 21	" 18	" 30	8.5	m	r c	b s	9	9
Judsonia	b	8.5	" 20	" 16	" 29	6	l	r b c	l c	7.5	7
Kansas	b	9.1	" 23	" 18	" 30	9.2	m	r c	d c	9.5	8.5
Karl	b	9.8	" 21	" 20	" 30	5	s	i	d c	6	6
Klickita	p	6	" 21	" 18	July 2	6	l	r d c	d s	9	7.5
Kossuth	b	9.2	" 22	" 17	June 28	7	l	r b c	d c	9.2	9
Kyle No. 1	b	9.8	" 23	" 18	July 5	9	m	r c	l s	6	6
Lanah	b	9	" 24	" 18	" 2	6	s to m	c	l s	8	9
Leader	b	9	" 21	" 18	June 30	8	m to l	l c	v d c	9	9
Leroy	p	9.8	" 21	" 19	" 30	9.5	l	d c	d c	9	9
Long John	b	9	" 16	" 15	" 30	7	l	v l c	b c	9	8.5
Lovett	b	9	" 21	" 18	" 25	8.5	m	r c	b c	8	9
Margaret	b	6	" 25	" 20	" 25	5	l	i	b s	9.5	8
Marshall	b	8.2	" 23	" 18	" 25	8	l	r c	d c	8.5	9
Marston	p	9.5	" 22	" 17	" 30	9.8	m	r d c	l r	7	8.8
Mary	p	9.1	" 23	" 19	July 5	8.5	l	b d c	b c	7	9
Maxwell	p b	8	" 24	" 18	June 28	6	m	r c	d c	8	9
Mayflower	b	9	" 22	" 19	" 25	------	------	------	------	------	------
Meridian	p	9.2	" 23	" 17	July 2	9	l	r c	d c	7.5	8
Meek	b	9	" 20	" 17	June 25	6	m	r c	l c	8.5	8.8
Mrs. Cleveland	p	9.5	" 22	" 19	" 29	8	m	r b c	b s	8	8
Mystic	b	9.5	" 22	" 19	" 30	8	m to l	r c	b d c	9	8
Nan	b	8	" 24	" 19	" 30	7	s to m	r c	l c	9.2	9
Nim Seedling	p	8	" 22	" 16	" 30	7	l	r c	b s	9.2	7.5
No. 1000.	p	8.5	" 24	" 16	" 30	7	l	b c	b d c	9	9
No. 15 W.	b	8.2	" 21	" 19	" 2	8	m to l	r c	l s	8	7
No Name	b	8.8	" 20	" 16	" 25	7.5	l	b c	d c	9	9
Ona	p	8.8	" 25	" 15	" 25	7.5	m to l	r c	b d s	9.8	8.5
Oriole	p	6	" 24	" 18	" 25	------	------	------	------	------	------
Orono	p	7.8	" 22	" 18	" 30	8	s to m	r c	v d c	8.5	9
Ostego	p	9	" 22	" 18	" 29	7.5	m to l	r d c	l s	8	8
Paris King	b	9.3	" 23	" 17	" 25	7	m	c	d s	8.5	8.5
Parker Earle	b	9.1	" 24	" 20	July 5	8.8	m	l c	d s	8	9
Phippen	b	9.7	" 24	" 18	June 30	9	m	l c	b c	8.8	9
Plow City	p	7.5	" 21	" 19	July 2	7	m	l c	b s	9	8.5
Pres. Carnot	b	5	" 23	" 19	June 25	------	------	------	------	------	------
Princess	p	8.8	" 22	" 16	" 25	8	m	r	c	9	8.5
Princeton Chief	p	9.1	" 23	" 19	" 30	8.6	l	l c	d c	8.5	8.8
Portage	b	9.2	" 24	" 20	July 5	9	l	l d c	l s	8	8.5
Purdue	p	8.8	" 24	" 14	June 25	9	m to l	r c	d s	8.5	9
Richmond	b	8.8	" 22	" 19	" 30	7	l	b c	d c	9.5	8.5
Rio	b	9	" 17	" 12	" 25	7.5	m	l c	b s	9	8.5
Robinson	b	9.2	" 23	" 19	" 30	7	m	r c	b c	7	8
Ruby	b	8.8	" 22	" 17	July 5	9	l	r d c	b r	9.5	9.5
Sadie	p	9.4	" 17	" 12	June 28	8	m	r c	d c	9	8
Sensation	b	5	" 23	" 17	" 24	------	------	------	------	------	------
Shawnee	p	9.5	" 20	" 18	July 5	9	m	l c	d c	9	[illegible]
Sherman	p	9	" 18	" 16	June 29	9	l	r c	d c	8.5	9

STRAWBERRIES.—CONCLUDED.

Variety.	Sex.	Vigor (1-10).	Date of bloom.	First ripe fruits.	Last fruits.	Pruductiveness.	Size.	Form.	Color.	Quality.	Firmness.
Smalley	p	8.8	May 20	June 16	June 25	4	m to l	r c	d c	7.5	9.8
Smith	p	9.5	“ 20	“ 14	“ 25	7	s	r c	r	8	8
Snowball	b	8.8	“ 21	“ 17	“ 30	9	l	l c	b s	8.5	9
Sparta	b	9.4	“ 22	“ 17	“ 30	8.5	m to l	l c	d c	9.5	9.5
Splendid	b	8.8	“ 21	“ 17	July 2	8	m	d c	d s	9	9
Springdale	b	9.2	“ 21	“ 18	June 30	8	l	r c	b s	8	8
Stahelin	p	9.8	“ 21	“ 16	“ 30	9.5	l	i c	v d c	9.5	8
Staples	b	8.5	“ 18	“ 15	“ 25	7.5	s	l c	v d c	9	8.5
Stayman	b	9.2	“ 17	“ 16	“ 25	7.5	l	r c	d s	8	8.5
Stewart	b	9.4	“ 19	“ 16	“ 25	7.5	s to m	d c	d c	8	9.2
Sunnyside	p	9	“ 22	“ 16	July 2	9	l	r c	l s	8.5	8
Sunrise	p	8.8	“ 22	“ 15	June 30	9	m	r c	b s	8	9
Surprise	b	6	“ 21	“ 18	“ 30	3	l	i c	b s	8	8.5
Tennessee	b	9.2	“ 20	“ 20	“ 29	8	m to l	r c	d c	9.5	9
Thompson No. 40	p	9.8	“ 25	“ 19	July 5	9.5	m	r c	b c	8.5	8.5
Thompson No. 64	p	8.8	“ 20	“ 16	June 30	8.5	m to l	i r c	b d s	8.5	9
Thompson No. 66	p	9.2	“ 22	“ 15	“ 30	9	l	l c	b d c	8	8
Thompson No. 103	b	8.2	“ 19	“ 16	“ 29	9	l	r d c	v d c	9.4	9.8
Timbrell	p	9.1	“ 21	“ 18	July 5	8.5	l	r c	v d c	9.5	8
Tonga	p	7	“ 22	“ 19	June 25	4	m	i r c	s	8	9
Topeka	b	9.2	“ 23	“ 19	“ 30	8	m to l	l c	d c	8	8.5
Tubbs	b	8	“ 23	“ 15	“ 25	7.5	m	r c	b s	9	6
Warfield	p	9.8	“ 20	“ 15	“ 30	10	m	l c	d c	8.5	9
Weston	p	9.5	“ 24	“ 19	July 5	8	l	b c	b c	8	8.5
Williams	b	9.2	“ 22	“ 16	June 30	8	m to l	r c	d c	9.5	8.5
Wm. Belt	b	7.5	“ 20	“ 19	“ 25	7	l	l c	l c	8.5	9
Woolverton	b	8.8	“ 24	“ 19	“ 25	8	m	l c	d c	8	9
Wyatt	b	8	“ 20	“ 16	“ 25	7	s	r c	d c	9.5	8.5
Yates	b	9.5	“ 22	“ 16	“ 25	5	s	r b c	l s	7	7

Arrow.—From Edward W. Cone, Menomonie, Wis. Imperfect flower. The plants are of strong, healthy growth, set a good crop of fruit and hold out well to close of season. The berries are of large size, long pointed conical in form, very dark crimson in color. The quality is high and the fruit moderately firm. Many of the berries are rather too long and narrow to make the best appearance in the box. The variety promises well in high quality of fruit, productiveness and vigor of plant growth.

Beebe.—From W. F. Allen, Jr., Salisbury, Md. Imperfect flower. Plants are of rather weak growth; those in hills are better than those in matted row. The berries are of good size and color, a little irregular in form and of good quality. The plants are not productive enough, and the variety seems to possess no special points of merit to give it prominence.

Blonde.—From G. Cowing, Muncie, Ind. Perfect flower. Plants are of good growth and healthy in foliage. The berries are of medium size, pointed conical in form, somewhat lacking in quality and rather soft. As the variety is low in productiveness it has little chance for prominence among the many better sorts.

Bostonian.—From New York Experiment Station, Geneva, N. Y. Perfect flower. Plants are of good growth, much more vigorous and healthy in matted row than in hills. Berries medium to large in size, round or flattened conical in form and of a bright scarlet color. The quality is of the best and the fruit is firm. Many of the berries on the truss were small and imperfect and the variety lacks productiveness.

Bouncer.—From W. F. Allen, Jr. Perfect flower. The plants are not of strong growth and make runners very slowly. The berries are of medium size, long conical form and very dark crimson color, having something of the appearance of Timbrell. Many blossoms failed to develop fruits and the variety is so lacking in plant and fruit qualities that it has little show for a place among the promising sorts.

Champion.—From David Strouse, Rogersford, Pa. Perfect flower. Individual plants are fairly vigorous but the variety makes few runners. Somewhat inclined to blight. Berries usually large, flattened, long conical in form, often irregular; color a dark scarlet; the flesh is light colored and a little inclined to be salvy. Quality rather poor and the fruit is soft. In productiveness it is somewhat below medium.

Cherokee.—From John Little, Granton, Ontario. Perfect flower. The plants are of strong growth and healthy. The fruits set well though many berries were imperfectly formed. Berry of medium size, round conical in form and scarlet color; the quality is good and the fruits moderately firm. Its bearing qualities are but medium and too many of the fruits are below marketable size.

Cruse No. 9.—From Stayman and Black, Leavenworth, Kan. Imperfect flower. Plants are rather weak in growth, though foliage is of good color and healthy. Berries are few in number but of good form. The color is too light and the fruits are soft. Further trial is necessary to determine the value of the variety.

Dakota.—From Stayman and Black. Perfect flower. Plants of strong growth and healthy. Berries medium to large in size, long pointed conical form, often with neck; color a bright scarlet. The quality is good though the fruit is rather dry and quite soft when ripe. The truss is long and reclining and the fruits lie on the ground. The variety is productive and excellent in plant qualities. The berry is rather long and slender for best form and too soft to carry well.

Dictator.—From C. A. Gardner, Dimondale, Mich. Imperfect flower. Plants are of but medium growth and seem quite subject to blight. The variety is but moderately productive and has no qualities of plant or fruit to make it especially valuable.

Early Bird.—From Ohio Experiment Station, Wooster, Ohio. Perfect flower. The plants were not of strong growth and the few fruits borne were of small size and imperfect in form. This season's trial was unsatisfactory.

Equinox.—From Thompson Sons, Rio Vista, Va. Perfect flower. Plants are of short, rather weak growth. They set well with fruit but could not mature the crop and the berries were small.

Farmington.—From R. Johnston, Shortsville, N. Y. Perfect flower. Plants are of quite vigorous growth and the foliage healthy. The variety did not blossom very full and there were a number of imperfect fruits, and blossoms that did not set. Berries are of good size and form, the color is attractive and the quality high. Fairly productive of firm fruits that are of high quality. It is well worthy of trial. Does well in hills.

Fremont.—From J. Little. Perfect flower. A strong, healthy grower and a good plant producer. It seems well adapted to hill culture. The berries are of good size, long conical, somewhat angular in form and bright scarlet in color. The flesh is bright, juicy, a little acid, but the quality is good and it is moderately firm. As the variety is strong in plant growth, productive, and the fruit very attractive in appearance, besides having the other qualities that make a good berry, it is a sort of much promise.

Gen. Fifer.—From E. J. Hull, Olyphant, Pa. Perfect flower but weakly so. Plants are of moderate growth and much better in matted row than in the hills. Berries of medium size, short round conical form and color a bright red. The flesh is bright, juicy, good quality and firm. The truss is upright and many of the fruits are borne above the plants and exposed to the sun. Many fruits were abortive and imperfect, and the plants seem quite subject to blight.

Gertrude.—From Slaymaker & Son, Dover, Del. Perfect flower. Plants are strong and healthy in both hills and matted row. But few berries borne, and the majority of them are small and imperfect. Unsatisfactory from this season's trial.

Giant.—From W. F. Allen, Jr. Perfect flower. The variety is not a good plant maker, though the individuals are vigorous and quite free from blight. The plants are doing better in the hills than in the matted row. Berries are large in size, round conical and regular in form and bright crimson in color. The fruit is very attractive in appearance, of high quality and firm. Were the plants more productive and of better growth, it would be a valuable sort.

Glen Mary.—From W. F. Allen, Jr. Perfect flower. The plants were set late the previous season and did not get a good start. The variety does not seem a strong plant maker though some plants are vigorous and the foliage is healthy. Berries are large, slightly angular, and even irregular in shape; color even, though not very attractive in appearance. The quality is good and the fruit firm. Requires further trial under more favorable conditions to test its merits here. Those in search of large fruits of good quality that are firm and look well should try this sort.

Granville.—Ohio Experiment Station. Perfect flower. Plant fairly vigorous and healthy but seems to be a poor runner maker. Some of the berries are very large, round or flattened conical in form and dark crimson in color. The quality is good but the flesh is mealy. While the variety bears some fruits that are very large, many are below the average in size and unsalable.

Hayes (*Prolific*).—From Rogers Nursery Co., Moorestown, N. J. Flower imperfect. Unsatisfactory in plant and fruit.

Homestead.—From Edward W. Cone. Perfect flower. Plants are of low growth, not very strong but the foliage is healthy. Berries are small and imperfectly formed. An occasional fruit is of medium size, round conical form, very dark crimson color and of high quality though soft. Lacks productiveness and size of fruits.

Ideal.—From M. Crawford. Perfect flower. The plants were set late in the season. They are of low, stocky growth and the foliage is healthy. Few blossoms appeared but nearly every flower developed a good berry. Berries of good size, round conical, usually sharply pointed in form and of a bright crimson color. The flesh is dark, juicy, of good quality and firm. The variety is excellent in plant qualities and the fruit very handsome in appearance and possessing high quality and firmness. Its future has much of promise.

Jerry Rusk.—From Ran Benoy, Matthews, Ind. Perfect flower. Plants of low, rather slender growth with considerable blight showing on foliage Berries are of medium size, bright dark scarlet color, round or flattened conical in form, often quite irregular. The fruits are of high quality and firm. Too many fruits set for the strength of plant and many were very small and imperfect. If more vigorous and healthy in plant, it would be a valuable sort.

Karl.—From Fred Stahelin, Bridgman, Mich. Perfect flower. Plants of very vigorous growth, as strong as any in the plot. The variety blossomed very full but many trusses failed to set a single fruit. The few berries borne were small, imperfect, lacking in quality and soft. Further trial is necessary.

Lanah.—From Ohio Experiment Station. Perfect flower. Plants are of vigorous growth and the foliage is healthy. The plants blossomed full but set few fruits and those are mostly small and imperfect. The berries ripen evenly and are firm. Further trial is necessary.

Marguerite.—From J. C. Grossman, Wolcottville, Ind. Perfect flower. Plants are of moderate growth, rather stocky, foliage is dark green and very healthy. The plants were set late and in rather a poor location. A few berries are large in size, flattened irregular form and a bright scarlet color. The flesh is bright, of high quality though rather soft. Under more favorable conditions the variety might prove valuable for home use.

Margaret.—From M. Crawford. Seems to be identical with above.

Marston.—From New York Experiment Station. Imperfect flower. Plants are of vigorous growth though the foliage is showing some blight. Berries are of medium size, round depressed conical in form, color a light red. The flesh is light in color, juicy and quite acid in quality, moderately firm. Much like Crescent in plant and fruit.

Nan.—From New York Experiment Station. Perfect flower. Plants of low, stocky growth and foliage healthy. But few fruits grew well, most of them being small and imperfect. A few berries were of large size, round or flattened conical form and a bright crimson color. The quality is good and the fruits firm. The variety lacks the plant qualities to set and develop a crop of fruit.

No. 1000.—From M. Crawford. Imperfect flower. The plants are of good growth and healthy, though set late and in a poor location. The truss is reclining and the fruits lie on the ground. Berries large, round conical, bright dark crimson color, very handsome in appearance, and the flesh is dark, juicy, firm and rich in flavor. Excellent in plant and fruit and, if more productive under favorable conditions, it will be a valuable sort for home use or market.

No. 15, W.—From Edw. W. Cone. Perfect flower. Plants are of low stocky growth, quite strong and healthy and much better in hills than in the matted row. Berries medium to large in size, short, round conical form; color a light scarlet. The flesh is light in color; lacks juice and quality and becomes quite soft when ripe. Nothing to give the variety special prominence.

Phippen.—From J. Little. Perfect flower. Plants of strong growth. Foliage is a light yellowish green, with leaflets long and narrow, and inclined to roll and turn yellow on edges. Plants in matted row are much better than those in hills. The truss is long and reclining and the fruits are borne on the ground. Berries are of medium size, long conical form;

color a bright scarlet. The flesh is bright, firm, juicy, rather acid but the quality is good. The habit and growth of the plant are poor and the berries are not large enough for a leading variety.

Plow City.—From Slaymaker & Son. Imperfect flower. The plants were set late and did not get a good start and were not strong enough to mature the fruits that set. The plants appear healthy and probably under better conditions would be much stronger. Berries of medium size, long pointed conical and a bright scarlet color. The flesh is juicy, bright, of good quality and firm. Requires further trial.

Portage.—From Ohio Experiment Station. Flowers perfect. Plants of vigorous growth and healthy. Not so good in hills. Berries very large, long flattened conical form; light scarlet color. The fruits are often hollow and have a hard core; flesh dry and mealy. The variety is strong and healthy in plant and productive of very large fruits that are low in quality, but as the berries are attractive in appearance it has a place as a show berry and for market.

Purdue.—From Indiana Experiment Station, Lafayette, Ind. Imperfect flower. Plants were set late and in a poor location, but made a good growth and the foliage was healthy. Berries of medium size, round or flattened conical, with apex depressed; color a dull scarlet. Flesh is dark, firm, juicy, quite acid in flavor but good. The fruit set well and held out to close of season. A promising sort but it requires further trial.

Ruby.—From Ohio Experiment Station. Perfect flower. Plants are not of very large growth but are vigorous and the foliage is healthy. Berries large, flattened conical, very regular and even in form; color is rich, dark, glossy red. Flesh a rich color, and juicy, firm and of best quality. The variety is excellent in plant, the berries are large, very handsome in appearance, and as the quality is very high and the fruits are sufficiently firm to stand shipment well it is a most promising sort.

Smith (Seedling).—From Slaymaker & Son. Imperfect flower. Plants of good growth and have healthy foliage. The variety blossomed full but few fruits set and they were small round conical, light red color and medium in quality and firmness. Further trial necessary.

Sparta.—From M. Crawford. Perfect flower. Plants of strong growth and very healthy in foliage. Berries medium to large size, rather long conical in form, usually with a neck; color dark crimson. The flesh is firm, of a rich color and high quality. It was grown in a poor location, but if under more favorable circumstances the plants prove more productive the variety will be valuable.

Sunrise.—From W. F. Allen, Jr. Imperfect flower. Plants are of fine growth and have healthy foliage. The plants in matted row are doing much better than those in hills. Berries of medium size, short, round conical form and bright scarlet in color. The flesh is dark, juicy, of fair quality and firm. The fruit holds out well in season but the majority of of them are somewhat under size. A variety of some promise.

Tubbs.—From W. F. Allen, Jr. Perfect flower. Plants are of medium growth and the foliage is healthy. Berries of medium size, round conical form and a bright scarlet color. The flesh is bright, juicy and has a sprightly flavor, but lacks firmness. It is an excellent sort to eat from the plants and may do for home use, but the berries are much too soft for market.

The following new sorts require another season's trial before a description can be given of them:

Benoy, Burnett, Dollar, Erie, Hilton Gem, Hunn, Laxton's No. 1, Michigan, Murray, Noble, Orange County, Premium, President Carnot, Sensation and Slaymaker No. 10.

NEW VARIETIES OF 1896.

Acem.—While very vigorous and healthy in plant produced but a small crop of berries and those borne were small in size, not of good form and rather soft.

Apache.—The plants were the strongest in growth of any in the field and the foliage was free from disease. A large crop of berries were borne but the form is long and narrow, the color bright and the fruits very poor in quality and soft. The variety will scarcely find a place in any planting.

Brooke.—The fruits are of good quality, firm and very attractive in appearance, but the plants are scarcely strong enough in growth to produce a large crop. The variety holds out well in season.

Bryant.—The variety is excellent in size, color, quality of fruit and in firmness, and the plants were of good growth and healthy. A small crop of fruit was produced, much less than that of last season. It requires further trial for productiveness.

Columbian.—Plants of vigorous and healthy growth. The fruits are of good quality and firm. The variety seems somewhat low in productiveness to become prominent.

Earliest.—This variety was not so early as last season when it ripened several days before any other early sort. The plants are vigorous and healthy but give but one or two pickings and then the crop is gone. Not worthy of general planting as an early sort.

Enormous.—The plants in matted row are much better than those in hills. The hill plants are not strong enough to mature a crop. The fruits are very large, but often quite irregular in form. The quality is high and the berries are firm. The variety has a long season and the plants are productive. This season's trial strengthens our report of last year when it was recommended as a sort of much promise because of productiveness, large size and the good quality and firmness of the berries.

Graham.—Has little in plant or fruit qualities to recommend it.

Holland.—This variety is in a poor location but the plants are vigorous and free from disease. It is but moderately productive and the berries often have a hard core; the quality is good and the flesh firm. If the variety proves more productive under better conditions it will be valuable.

Hull's No. 3.—Proved unsatisfactory this season.

Jarbalo.—The variety is quite vigorous and the foliage healthy. The berries are lacking in attractive appearance and in quality. As the sort is but moderately productive it has no qualities to give it special prominence.

Kansas.—Plants are of good growth, though some blight is showing. This year the fruits were much smaller in size than last season. The berries are of high quality and firm and the plants productive. Too many of the fruits were too small to pick, otherwise the variety is a most excellent one. In hills the plants were strong and the fruits much larger in size. Worthy of trial in hill culture.

Kossuth.—Excellent in every way but the plants were not so productive as last season. Well worthy of trial as under other conditions it may prove more productive.

Mary.—The plants are vigorous and healthy. The fruits large, good color and firm, but very sour. The plants are fairly productive and the sort has some promise as a market berry.

Meridian.—Excellent in growth of plant. The variety does well in hills. It is productive and the berries are large, well formed and hold their size to the close of a long season. An excellent market sort if a little firmer. Lacks quality.

Ona.—This variety was not so vigorous in plant growth or so productive as last season. The handsome appearance of the fruit and its high quality still make it a variety worthy of trial.

Orono.—Lacking in plant vigor and productiveness this season, and too many of the fruits were small. Plants did much better in hills than in matted row. Fruits of good quality and firm, but small.

Ostego.—Lacking in productiveness and has no qualities of plant or fruit to give it special prominence.

Paris King.—Plants of good growth and healthy. But a small crop of fruit and too many berries were small and imperfectly formed.

Sherman.—The plants are of good growth, the fruits large, of good color and firm, though sometimes quite imperfectly formed. As the variety is productive it is of some promise as a market berry.

Smalley.—Last season this variety made an excellent showing in productiveness and size of fruits. This year the plants set full of berries but the fruits failed to develop and the plants dried up.

Splendid.—The plants are not of large growth but are strong and healthy. The berries are not large and their appearance is not attractive, but they are of high quality and firm. Scarcely productive enough to bring the sort into prominence as a profitable variety.

Staples.—Unsatisfactory in plant growth. Unproductive and the berries small.

Thompson No. 103.—While the plants are not of very strong growth the foliage is free from disease. The berries are large, of good color, high quality and firm. Often the fruits do not ripen well on the under side. The variety is quite productive and as the berries present a very attractive appearance and possess the firmness necessary, it promises well as a market sort.

Wyatt.—The berries are of high quality, otherwise the variety was very unsatisfactory this season. Further trial is necessary as ast year's report was quite favorable.

Yates.—Plants of vigorous, healthy growth, but the crop was small and the berries under size, poor in quality and soft.

Some of the following are old and well known sorts that have been tested for years—all have been tested for at least three seasons:

Aroma.—The plants are strong and healthy. The berries are large, regular in form, of fine appearance and good quality. The season is late and well extended and the last fruits are large. Well worthy of planting for a late berry.

Bird.—Is strong and healthy in plant growth, the berries are large, attractive in appearance, of high quality and the flesh is firm. It has borne a large crop of fruit every season and seems deserving of a high place as a market sort.

Beder Wood. Has long been recognized as a valuable fertilizer for pistillate varieties. The berries are light colored and rather soft.

Biel. Is good in plant growth and fairly productive. The fruits are of fine appearance, good quality and firm. Too many of the berries are below size to make the variety a profitable one for the market grower.

Brandywine. The berries are large, of good form, pleasing appearance, and high in quality. The season is quite late, it holds out for a long time and the last fruits are large.

Brunette. Because of its fine appearance and high quality well deserves a trial in every garden. The berries are of good size and quite firm. The plant is a good grower.

Bubach.—Is a well known sort and one that is largely grown. It is not so productive as Crescent or Warfield but the berries are considerably larger and it is a valuable variety on strong soils.

Charlie. The plants were much stronger in hills than in matted row and the fruits larger. It is of good growth, berries of good quality and fairly firm. On rich soil, with high culture and grown in hills, this sort would doubtless prove profitable as a market berry.

Clyde.—Last season this was our most productive variety. This spring the plants blossomed very full but the variety does not root deeply and the plants could not mature the large crop of fruit that set. The foliage dried up and many plants were entirely killed. Usually a very profitable variety though the berries are rather light in color and not so firm in flesh as desirable.

Crescent.—Is still very largely planted. The berries are not large, the quality is poor and its appearance is not attractive, but it is one of the most productive sorts grown under usual conditions of treatment. It would seem that some of the larger fruiting sorts that are better in quality and appearance could profitably take its place.

Eureka.—This variety is a strong grower and productive. The berries are large but are not of very high quality and but moderately firm. The season of ripening is a long one and the berries are uniformly large. It is well worthy a place as a late berry.

Gandy.—This variety has been largely planted as a late market berry. The fruits are large but not enough of them are borne.

Greenville and *Weston.*—Are excellent in plant growth and fairly productive of good sized fruits. In quality and firmness the berries are medium. Both sorts are attractive in appearance and well worthy of trial for market.

Haverland.—This variety, though scarcely so productive as Warfield, has fruits that are much better in quality and larger in size than that sort. Taking productiveness, size and quality together, no variety ranks much higher than Haverland for home use or local market.

Leroy.—This variety has been grown here since 1893. The plants have been strong and healthy in growth and uniformly productive of large crops of berries. The fruits are large, fine color, regular in form, of high quality and firm. It should be given a trial as a market sort.

Marshall.—The berries are large and uniform in size, of good quality and firm. The plants are of medium growth and somewhat subject to rust. Many report this variety as one of the best for large sized fruits and for productiveness. It has not shown any remarkable qualities in plant or fruit here, but is a sort that should be tried by anyone in search of a variety bearing large berries that are of good quality and firm, for use on strong soils. The fruit is rather dark and the foliage is subject to rust.

Mrs. Cleveland, *Princeton Chief* and *Topeka* are good in plant growth and fairly productive of berries that are good in quality but scarcely firm enough to stand shipment well.

Parker Earle on strong soil and with plenty of moisture is a most valuable late market sort. Under other conditions the plant sets more fruits than it can mature.

Shawnee.—Berries of large size, dark rich color and of high quality. The plants set a large crop but the last fruits were small. Season rather late. Fruits ripen somewhat unevenly.

Snowball.—This season the plants were not so strong in growth as they have formerly been. The berries are very handsome in appearance, of good quality and firm. If the growth of plant is good the variety is very promising for market.

Stahelin.—The plants are of strong, healthy growth and productive. The berries are large, of very fine appearance and high quality. For near market or home use this is a most excellent sort.

Thompson No. 40.—This is another sort that has been tried for several years and with best results. Very strong and healthy in plant and very productive. If the berries were larger in size this variety would be one of the best grown.

Thompson No. 66.—The fruits are larger than No. 40 but the variety is not so productive. Has shown up well for the several seasons tried but has no extraordinary qualities.

Timbrell.—Though but moderately productive and the fruits have a mottled appearance that makes them unattractive, the high quality of the berries and their large size make this a valuable sort for home use.

Warfield.—Taking all points into consideration, it is doubtful if there is a more profitable variety for the general planter than the Warfield. In productiveness and appearance it ranks very high. If the size of the fruits could be increased and the quality improved it would be the ideal berry.

Epping, *Huntsman* and *Iowa Beauty*, while possessing excellent qualities of plant and fruit, are not productive enough to become profitable sorts.

No Name produces too many small fruits.

Maxwell, *Rio* and *Wm. Belt* have in previous seasons made a good showing. This year they were unsatisfactory in plant and fruit.

SUMMARY OF VARIETIES.

The most promising of the new sorts, taking all points into consideration, are Arrow, Farmington, Fremont, Glen Mary, Ideal, Marston, Purdue and Ruby.

Of the varieties that have been tested two seasons the following have the most promise: Enormous, Kansas, Mary, Meridian, Ona, Sherman and Thompson 103.

It is doubtful if there are more profitable varieties for the market grower than Bubach, Crescent, Haverland, Warfield, and on strong soil the Parker Earle. Bubach is not very productive and Crescent is poor in quality and often undersized. Beder Wood and Sharpless are good fertilizers for these imperfect kinds. Clyde is an early bloomer, with abundant pollen and should be tried as a fertilizer. Woolverton is also good.

Among sorts not so widely known as the above but which have given excellent results as market berries are Bird, Charlie, Greenville, Leroy, Snowball and Weston.

For the grower in search of varieties that will bear large fruits and that are fairly productive, Brandywine and Marshall are recommended.

Aroma and Eureka bear large fruits, ripen late and have a long season. They are well worthy of trial as late varieties.

Brunette and Timbrell are large fruiting kinds that are very high in quality. They are recommended for home use.

L. R. TAFT.
H. P. GLADDEN.

Agricultural College, Mich., Aug. 12, 1897.

FEEDING DAIRY COWS.

BY C. D. SMITH.

Bulletin 149.—Farm Department.

SUMMARY.

It is not the purpose of this bulletin to present a text-book on the different phases of cow feeding, nor to bring together the results of the work of other Stations on the points touched upon. But, after illustrating the meaning of the terms which it is necessary to use in describing feeding experiments, to outline the method of calculating rations. A table is presented giving the amount of dry matter and of each of the digestible nutrients, protein, carbohydrates and fat in many of the common cattle foods. This table is based upon the analyses reported by Jenkins and Winton, combined with the American digestion coefficients. Many of the analyses were made by the chemical department of this Station.

Following the computation of rations, there is given a summation of the results of the feeding of the College herd for the last three years in relation to the amount of dry matter and of digestible nutrients consumed per day, per thousand pounds live weight, by good dairy cows in full milk or in the very latest stages of the period of lactation. The publication of Armby's Manual of Cattle Feeding in 1881 called the attention of American cattle feeders to the ration recommended by Prof. Wolff and since known as the German standard ration. The publication of Bulletin 38, of the Wisconsin Experiment Station showed to the keepers of dairy cows that the consensus of opinion of the most progressive dairymen was in favor of a smaller amount of protein per day than had been suggested by Wolff. It was unfortunate that this American standard ration, so called, had to be based on amounts of feeding stuffs whose weight was often assumed rather than measured. The fact that for three winters the feed of each cow had been carefully weighed and not infrequently analyzed, places in the hands of this Station, a large amount of data available as evidence in formulating the average ration for a dairy cow. The quantity fed per day of the different factors in the ration was regulated by the judgment of an expert feeder, and the answer which the cows have returned to the question of how much they can best utilize per day cannot fail to be significant. *This answer is that a thousand pound cow, in the fourth month after calving, while yielding on the average 1.21 pounds of fat*

daily, requires 23.57 pounds of dry matter, 2.06 pounds of digestible protein, 12.50 pounds of digestible carbohydrates and .89 pounds of digestible fat.

A discussion of some of the feeding stuffs used at the College follows, in which the results of many experiments are briefly reported.

Sorghum and kaffir corn yielded large amounts of forage per acre, in which the per cent of dry matter was lower than in corn and the protein content was conspicuously low. Neither is recommended as a substitute for corn.

Clover hay is valuable because supplying a large per cent of protein, and because deriving its nitrogen largely from the air. After the removal of the crop of hay, as much nitrogen was left in the roots as would be supplied by 7 tons of barnyard manure per acre. Clover silage is palatable to cows but the method of ensiloing clover is not recommended because of the expense.

Vetches, crimson clover, peas, and alfalfa were grown and the results are reported.

Roots are recommended, the plot experiments showing the greatest return in dry matter per acre by sugar beets, with rutabagas second and carrots third. The labor in growing and harvesting an acre of roots is shown to be 32.8 hours for man and team and 209.9 hours for man. The addition of roots to a ration of clover hay, corn meal and wheat bran was shown to affect the digestibility of certain factors. More of the N. free extract, crude fiber, ash and dry matter were digested when mangolds were fed than when the ration was fed without succulent foods. The addition of potatoes instead of roots increased the digestibility of the N. free extract, but decreased the digestibility of the protein, crude fiber, fat and total dry matter.

The addition of potatoes to a normal ration increased the length of time required to churn the cream and in one experiment increased the hardness of the butter.

Seventeen analyses of bran show that the composition of burr stone bran differs from the product of the roller process in containing less fat. A sample of first grade bran, so called, contains nearly two per cent more protein than either the second or third grade.

A description of a new and cheap dairy barn concludes the bulletin.

DEFINITION OF TERMS.

There are a few terms used in the literature relating to cattle feeding the meaning of which ought to be clearly understood. Among these terms are dry matter, protein, carbohydrates, and digestibility.

All of our cattle foods, no matter how dry they may seem, contain water. If first dried in the open air, then pulverized and exposed for a longer period to a perfectly dry atmosphere and a low heat, it is easy to understand that nearly, if not quite, all the water in the original substance would be driven off and the residue would be rightly called dry matter. The water which was driven off by the heat and taken up by the air has no value for feeding purposes, whether it comes from hay or from mangolds or turnips. Roots are not valuable because they contain water, but because of the amount and composition of the dry matter that would be left were all the water dried out of them. In the comparison of stock foods, then, the only fair basis is the dry matter which they contain.

The meaning of the word *protein* is a little harder to illustrate. A reference to the diet of human beings may aid in making its significance clear. No dinner seems complete without some kind of meat. Lean meat contains in the first place a large amount of water. If this were driven off, the dry matter would be found to consist of the red muscle, fat and a small amount of connective tissue. It is the red muscular tissue that is the characteristic constituent of lean meat. If meat is wanting, the house wife finds it possible to supply its place with eggs. One hundred pounds of eggs contain not far from sixty-six pounds of water, 9.5 pounds of fat and 13 pounds of albumen, a material having a chemical composition very similar if not identical with that of the dry, red muscle of lean meat. If eggs were not obtainable as a substitute for meat, its place might be acceptably filled by a sufficient quantity of cheese. One hundred pounds of Cheddar cheese contain 35.6 pounds of water, 32 pounds of fat and 28.2 pounds of casein, a substance having also a chemical composition very similar to that of the dry lean muscle of lean meat. Now this class of substances to which belong dry lean meat, the albumen of the white of eggs, and the casein of cheese, is called *protein.*

All of our cattle foods contain compounds having a composition similar to the protein of lean meat, eggs and cheese and serving for our domestic animals the same purpose that the protein of meat, cheese and eggs does for human beings.

It must not be understood that meat and eggs and cheese are the only articles of human diet that furnish protein. The truth is far otherwise. While meat and some animal products have a larger proportion of protein than do most vegetables, the latter are by no means wanting in it. Even potatoes, a very starchy food, contain, when boiled, on the average, 2.7 pounds of protein for every hundred pounds of gross weight. Beans have a much larger per cent of protein, on the average 21.81 pounds to the hundred weight. White bread contains 9.5 per cent of this valuable nutrient. The limited number of experiments that have been tried on this point lead us to believe that a pound of protein derived from potatoes is equally as valuable as the same amount derived from lean meat, though this point has not been well established.

Turning now to cattle foods, there are some of them that may be supposed to be related to the appetite of the cow in the same way that eggs, cheese and meat are to the appetite of men. To this class of cattle foods would belong such materials as cotton seed meal, linseed meal, buckwheat middlings, and possibly wheat bran and middlings. One hundred pounds of cotton seed meal contain 42.4 pounds of protein while the same weight of cheese would have but 28.2 pounds. Linseed meal, old process, has in each hundred pounds 32.9 pounds of protein while eggs, the typical proteid substance of the human dietary, contains but 13.1 pounds of protein per hundred weight. Men eat eggs and meat because the protein they contain satisfies hunger for that ingredient. So the appetite of the cow calls for materials containing protein and is satisfied when fed on relatively small quantities of feeding stuffs of this class rich in protein.

Chemical examination has shown that protein contains on the average about 16 per cent of the element nitrogen, and that protein compounds are quite uniform in this respect. Because of this fact the protein compounds of cattle feeding stuffs are called not infrequently nitrogenous compounds.

Fat.—The meaning of the word fat in relation to cattle feeding is the same as when used in ordinary conversation. The fat found by the chemist to exist in clover hay, corn meal, and other feeding stuffs is very similar in composition to animal fat like lard, butter fat or tallow. The quantity of fat existing in the various feeding stuffs varies within very wide limits. Of the total weight of the seeds of the flax and the cotton plants fully one quarter is oil, while mangolds, straw and green fodders contain relatively little fat. The fact that nearly all of our fodders do contain fat is the one which it is important to remember.

Carbohydrates.—Both protein and fat are essential constituents of the diet of mankind. But not a single meal would be deemed complete in this latitude if it consisted wholly of a combination of these two nutrients. The appetite calls for some starchy food. This is usually supplied by potatoes or some other vegetable. Boiled potatoes are composed of approximately the following constituents in the proportions, indicated: water, 73.7 per cent; protein, 2.7 per cent; fat, .2 per cent; and starch 22.3 per cent. Honey and syrups are composed almost entirely of sugar. In the animal economy it has been pretty clearly shown that the sugar and starch serve as a source of energy. For reasons that need not be discussed here the chemists have used the term carbohydrates as the name of the class of nutrients which includes both starch and sugar.

In cattle feeding the materials with which we have to deal contain a large proportion of fibrous material. These woody matters are digested to some extent in the intestines of the cow. The chemist distinguishes between the crude fiber of the forage crops and the more soluble starch and sugar and similar compounds. The former he calls crude fiber, and the latter, nitrogen-free extract because containing no nitrogen. As far as digested, however, all of these materials are equivalent to starch, and in the following discussions the digestible crude fiber will be reckoned under the general term of carbohydrates. In the human diet the potato stands well up in the list of the articles furnishing the most carbohydrates since it contains, when boiled, 22.3 per cent of starch and other carbohydrates. Other vegetables are also relatively rich in starch, sugar and woody fiber all of which are carbohydrates. In cattle foods our common field-cured fodder corn contains per hundred weight, 36.5 pounds of the soluble carbohydrates, called by the chemist nitrogen-free extract, and 22.1 pounds of the less soluble but still partly digestible crude fiber, both are, of course, carbohydrates.

Carbohydrates make up the bulk of the stems and leaves of our forage crops and are the principal constituents of our grain feeds as well.

Ash.—The ashes remaining when a feeding stuff is burned have a certain part to play in the nutrition of animals. While there is usually no lack in ordinary feeding of this constituent of fodder, sometimes in the case of young animals fed very largely on grain as in the case of pigs fed on corn, the lack of the ash element shows itself in the weak bony structure of the animal and in a general lack of thrift.

Digestibility.—While the stomach and intestines of the dairy cow are especially adapted to the digestion of coarse feed, a share of the valuable parts passes through her without digestion. All of the materials we have described, the protein, the carbohydrates and fat, are more or less encased in toughened cells in such a way as to prevent the ready access of the fluids of the stomach and bowels. Were it not for the very large stomach of the cow in which her food soaks in liquids which soften it for the second grinding it receives when she chews her cud, and for the great length of her intestinal canal varying from twelve to twenty times the length of her body, nearly all of the coarser parts of the forage crops must escape digestion. As it is, with this complicated and effective apparatus, which nature has provided, but little more than half of some of the valuable nutrients of the forage crops are absorbed into the circulation of the cow and became really useful to her.

To determine what share of the food consumed is really digested by the cow, extensive experiments have been performed both in the Old World and in this country.

The first step in one of these digestion experiments is by chemical analysis to find out how much protein, carbohydrates and fat one hundred pounds of the food stuff in question contains. Two animals are then weighed daily for a week and fed a weighed daily ration of the material to be tested. At the end of that time the real experiment begins. The animals are weighed daily for the next period, usually of six or seven days, and both the amount of food they consume and the amount of excrement they void are carefully weighed and analyzed. From the data thus obtained, the amount of protein, carbohydrates and fat digested is found by subtracting the amounts of each in the dung from the amounts of each in the feed which the animals consume, in the given time. For instance suppose it was desired to determine what share of the nutrients, protein, carbohydrates and fat, cattle were able to extract from clover hay and utilize in their bodies. Two steers would be fed clover hay for a week, the ration being so regulated that there would be neither gain nor loss in weight. Let us next suppose that the following period of the experiment was six days, and that in that time each steer consumed twenty pounds per day of clover hay. The clover hay would contain as shown by chemical analysis per hundred pounds

Water	15.3 pounds.
Ash	6.2 pounds
Protein	12.3 pounds.
Crude fiber	24.8 pounds.
Nitrogen-free extract	38.1 pounds.
Fat	3.3 pounds.
	100.00 pounds.

In the six days, each steer would consume 120 pounds of clover hay, containing according to this analysis 14.76 pounds of protein. For, if one hundred pounds of hay contained 12.3 pounds of protein, one pound of hay would contain .123 pounds which, multiplied by 120 gives 14.76, as the total amount of protein in the 120 pounds of clover hay consumed in the six days. By using the table of analysis in this way we find that in the 120 pounds of clover hay there would be, besides the 14.76 pounds of protein, 29.76 pounds of crude fiber, 45.72 pounds of soluble carbohydrates, or nitrogen-free extract as they are here called, and 3.96 pounds of fat.

Let us suppose next that the dung for these six days is weighed, sampled and analyzed. It would weigh not far from 25 pounds per day per steer, or 150 pounds for the six days. A chemical analysis would show that this dung contained, per hundred pounds, 4.702 pounds of protein, 10.55 pounds of crude fiber, 11.89 pounds of nitrogen-free extract and 1.373 pounds of fat. The hundred and fifty pounds of this material would contain 7.08 pounds of protein, 15.77 pounds of crude fiber, and 17.83 pounds of nitrogen-free extract and 2.06 pounds of fat. These materials having passed through the body and been excreted from it unaltered, could not have been digested. If therefore, we subtract the amounts of each nutrient in the dung from the amounts of the same material in the food consumed we shall have the amount digested, the amount taken out of the food by the digestive organs of the animal and utilized in its growth or maintenance. This is done in the following table.

	Protein.	Crude fiber.	N. free extract.	Fat.
	lbs.	lbs.	lbs.	lbs.
In 120 pounds hay	14.76	29.76	45.72	3.96
In the 150 pounds dung	7.08	15.77	17.83	2.06
Amounts digested	7.68	13.99	27.89	1.90

Taking the protein as an example, we can determine the proportion of it digested by dividing the 7.68 pounds by the weight of it given in the feed, 14.76 pounds, the result would be 52, the per cent of protein of clover hay digested by the steer. In the same way the per cents digested of the other constituents of the ration are found. This would be for crude fiber 47 per cent, for nitrogen-free extract 61 per cent, and for fat 48 per cent. Results thus obtained are called *digestion coefficients.* The digestion coefficient of the protein of clover hay is 52. The digestion coefficient of crude fiber in this experiment would be found in the same way to be 47, that of the nitrogen-free extract 61 and that of the fat 48.

The two steers are fed and treated exactly alike. If both animals are normal and healthy and no mistakes are made in the prosecution of the experiment, the digestion coefficients found by one steer should coincide very closely with those found by the other. Repeated experiments have shown that cows do not differ much as to the amounts of protein, carbohydrates and fat they can digest from the same material. The digestion coefficients found by one animal therefore will hold good approximately for all other animals of the same species. It is not true on the other hand, that the digestion coefficients of one fodder will apply to any other. For instance, while but 52 per cent of the protein of red clover is digestible by cows, 73 per cent of the protein of pasture grass was found digestible in Pennsylvania, while of timothy less than half the protein was found digestible at the Maine and Utah Experiment Stations. Of the protein of corn silage about 53 per cent is digestible. The protein of linseed meal is much more digestible, fully 87 per cent of it being utilized by the cattle. The protein of wheat bran is also highly digestible, the digestion coefficient being 78.

An examination of the records shows that what is true of the protein in this respect applies with equal force to the carbohydrates and fat. While the carbohydrates of the grains and by-products are very largely digestible, a good deal of the starch and other carbohydrates of the rough forage is so encased in woody fiber as to escape the action of the digestive fluid in the intestinal canal. Because of this variation in digestibility among the forage crops and other cattle foods it has been found necessary to try digestion experiments with each of them. To insure accuracy, these experiments have been carried on with at least two animals at a time and in most cases have been repeated several times, the results being in the main concordant.

It is evident that in estimating the value of a given cattle food we ought to take into consideration the digestible part only. The share of the protein for instance that, under ordinary circumstances, passes through the cow undigested is of no value as far as she is concerned and should not be counted upon in calculating the amount of material she should receive in her daily ration. In comparing two fodders also it is not enough to know how much of the total nutrients each contains, we must know in addition the share that is digestible. Having determined the proportion of digestible protein, carbohydrates and fat in each of our fodders we will thereafter take account of those digestible parts only. For instance in the clover hay above but 52 per cent of the 12.3 per cent of protein was digestible, or 6.4 per cent. While there was 24.8 per cent of crude fiber in the clover hay but 47 per cent of it was digestible or 11.65 per cent of the clover hay was digestible crude fiber. Of the 38.1 per cent of nitrogen-free extract but 61 per cent was digestible, or 23.24 per cent of the clover hay was made up of digestible nitrogen-free extract. In the same way remembering that but 48 per cent of the fat was digestible we find that the clover hay contained 1.58 per cent of digestible fat. The digestible crude fiber and digestible nitrogen-free extract are of equal value and are combined for the digestible carbohydrates. The 11.65 per cent of digestible crude fiber added to the 23.24 per cent of nitrogen-free extract makes 34.89 per cent of digestible carbohydrates. Summing these results of the combination of the chemical analysis of clover hay and the digestion experiments we have the conclusion that clover hay contains 6.4 per cent of digestible protein, 34.89 per cent of digestible carbohydrates and 1.6 per cent of digestible fat.

COMPOSITION OF FEEDING STUFFS.

Chemical analyses have been made of all of our common feeding stuffs at the Experiment Stations in the different States. The average of a large number of analyses has eliminated the errors which might have been suspected had but one or two tests been made. With most of the feeding stuffs digestion experiments have been performed. In the following table these results have been brought together and the table sets forth the amount of dry matter, which the given fodders contain and in the succeeding columns the per cents of digestible protein, carbohydrates and fat.

TABLE I.—*Dry matter and digestible material in one pound.*

	Dry matter.	Protein.	Carbohydrates.	Fat.
Green fodder:	lbs.	lbs.	lbs.	lbs.
Corn fodder:				
Flint, cut early	.202	.0122	.1257	.00518
" after glazing	.229	.0128	.134	.0059
Dent, cut early	.21	.01173	.1238	.0033
" after glazing	.266	.0 06	.1524	.007
Sweet	.209	.01159	.12156	.0037
Leaves and husks	.3046	.011	.1 07	.0037
Stripped stalks	.239	.00305	.15479	.0037
Sorghum	.1991	.0019	.123	.0037
" leaves	.2262	.0168	.1166	.006
" stalks	.2182	.0027	.1425	.0049
Kaffir corn	.2547	.0051	.1365	.0046
" " leaves	.288	.031	.1312	.0134
" " stalks	.2389	.0042	.1444	.002
Timothy before bloom	.384	.022	.23	.007
" after "	.41	.0139	.212	.00689
Orchard grass	.27	.0152	.1143	.0016
Millet	.25	.018	.118	.003
Green oats	.378	.027	.227	.01
Red clover	.292	.029	.141	.007
Alsike clover	.25	.027	.131	.006
Peas and oats	.16	.018	.071	.0024
Rape	.13	.02	.048	.004
Pasture grass	.2	.026	.106	.005
Cabbage	.097	.021	.058	.004
Pumpkins	.21	.004	.071	.001
Silage:				
Corn, immature	.1981	.0041	.1131	.0059
" mature	.21	.009	.1144	.0062
Sorghum	.239	.006	.149	.002
Kaffir corn	.2409	.0046	.1436	.0064
Pea	.4992	.0461	.2806	.0124
Red clover	.28	.02	.135	.01
Alfalfa	.359	.014	.204	.01
Hay and dry coarse fodder:				
Corn fodder	.578	.026	.333	.011
" stalks	.599	.02	.334	.006
Timothy, cut early	.85	.0293	.41	.0147
" " late	.859	.0244	.4288	.0108
Mixed hay	.84	.026	.427	.01
Orchard grass hay	.86	.049	.399	.014
Hungarian hay	.923	.015	.464	.01
Millet hay	.9135	.0408	504	.01
Oat hay	.911	.042	.427	.015
Red clover hay	.847	.065	.349	.016
Alsike clover hay	.903	.058	.368	.014
Mammoth clover hay	.788	.057	.32	.019
Alfalfa hay	.916	.076	.378	.013
Pea vine hay	.864	.043	.323	.008
Peas in bloom	.833	.094	.331	.016
Wheat straw	.914	.008	.379	.005
Oat straw	.908	.016	.414	.007
Rye straw	.929	.008	.427	.004
Roots and tubers:				
Potatoes	.21	.0127	.1557	----------
Table beets	.115	.009	.076	.001
Mangolds	.091	.0087	.061	.002
Sugar beets	.135	.011	.093	.001
Turnips	.095	.0063	.0668	.002
Ruta Bagas	.114	.009	.071	.002
Carrots	.114	.01	.071	.003
Artichokes	.20	.02	.168	.002

TABLE I.—*Concluded.*

	Dry matter.	Protein.	Carbo-hydrates.	Fat.
Grain:	lbs.	lbs.	lbs.	lbs.
Corn:				
Dent	.894	.0713	.6303	.041
Flint	.887	.073	.645	.03
Sweet	.912	.0916	.6202	.0502
Barley	.891	.095	.661	.012
Oats	.89	.091	.447	.041
Rye	.884	.083	.655	.012
Wheat	.891	.092	.649	.014
Buckwheat	.874	.077	.492	.018
Millet seed	.86	.095	.45	.026
Sunflower seed	.92	.104	.246	.212
Beans	.678	.181	.3559	.016
Mill products:				
Corn meal	.864	.07	.66	.035
Corn and cob meal	.894	.076	.587	.031
Pea meal	.895	.18	.56	.009
Pea bran	.877	.056	.463	.02
Ground flax	.877	.172	.189	.352
Corn and oats, equal parts	.892	.0862	.549	.036
By-products:				
Linseed meal, old process	.908	.283	.328	.071
“ “ new “	.90	.307	.384	.027
Cotton seed meal	.918	.369	.181	.123
Buckwheat middlings	.873	.22	.334	.054
Gluten meal	.904	.288	.393	12
“ feed	.903	.183	.486	.097
Wheat bran, old process	.88	.101	.475	.026
“ “ “ “	.908	.125	.412	.012
“ “ roller “	.88	.126	.441	.029
“ “ “ “	.90	.1287	.406	.023
Rye bran	.884	.097	.48	.026
Wheat middlings	.879	.122	.472	.029
Rye middlings	.907	.119	.451	.016
Dried Brewers' Grains	.923	.162	.355	.053
Malt sprouts	.904	.198	.362	.017
Corn cobs	.893	.016	.439	.003
Apple pomace	.133	.01	.119	.011
Skimmed milk	.096	.031	.047	.008
Buttermilk	.099	.039	.04	.011
Whey	.066	.008	.047	.003
Apples	.152	.003	.128	.002

The table here given is compiled from various sources and represents the work of many experiment Stations. Some of the chemical analyses were made at this Station and are brought into this table by use of the American digestion coefficients found in Vol. VI of the Experiment Station Record, page 7. Others are taken from the table in Woll's Dairy Calendar, 1895, pages 260 e. s., which in turn were largely compiled from Jenkins and Winton's tables of Analyses of American Feeding Stuffs.

FEEDING STANDARDS.

It is evident that these tables, while giving for the different feeding stuffs the amounts of dry matter and of digestible protein, carbohydrates and fat, can be of but little use to the farmer who does not know how much of each of these materials a cow requires per day. These tables aid him by translating the various foods into terms common to all of them. A practical feeder has found that 35 pounds of silage, 10 pounds of clover hay, and 10 pounds of wheat bran per day make a ration that keeps a thousand pound cow in good condition and allows a full flow of milk. A trial of this ration for a period of reasonable length, say for a whole winter, noting the results in the increase of live weight of the cow or in milk and butter yielded, is a valuable experiment. Other dairymen want to profit by the results of this experiment but one of them has silage and no clover hay, and another has clover hay but no silage. How can these cow feeders gain anything from the experience of the first dairyman?

Beginning in Germany and France a host of experiments were performed with dairy cows in full milk. All sorts of fodders and grain feeds were used. A record was kept of the amounts of each consumed, the resulting yields in milk and butter were recorded, the various foods were analyzed and digestion experiments performed with them. From the results of a multitude of such experiments performed partly by practical feeders and partly by the German experiment Stations, Dr. Emil Wolff, the Director of the Hohenhein Experiment Station, after careful study proposed a feeding standard for milk cows per day and thousand pounds live weight. Taking the average of a great number of experiments and practical feeding trials he found that the medium sized cows of Germany giving a satisfactory flow of milk, required sufficient food to furnish daily 24 pounds of dry matter; that in this dry matter there was two and one half pounds of digestible protein. He found farther that, with the ordinary feeding stuffs obtaining in Germany, 24 pounds of dry matter containing 2.5 pounds of protein would contain also 12.5 pounds of carbohydrates, and a little less than one half a pound of fat.

Prof. Wolff farther suggested as an observation justly warranted by the results of the many experiments whose records were before him, that to secure the best results, for every pound of protein in the ration there should be fed about five and four tenths pounds of non-nitrogenous material. It is believed that one pound of fat is equal in feeding value to two and one quarter pounds of digestible carbohydrates. In estimating the non-nitrogenous materials to compare with the protein, the fat of the ration is multiplied by two and one quarter and added to the digestible carbohydrates.

It is not necessary here to go into a discussion of the part played by protein in the nutrition of the cow. The transformations which take place in her body are still largely enveloped in mystery. It is a matter of experience, however, that where the cow receives less than two and one-half pounds of protein per day she cannot make her maximum yields. She has no creative ability, she can simply transform the materials of her food into flesh or fat or milk. The composition of the latter is fixed. For every pound of fat she secretes in her milk she must produce, with it, fully a pound of casein, a material practically identical in composition with the protein of her food. Again an uncertain, but not small amount of protein must be used up in the body to carry on the vital functions. The sum of these two demands, for the casein of the milk and for the support of life, it not less than two and one-half pounds for a cow of average size in normal condition and giving a fair flow of milk. These were the conclusions of Prof. Wolff.

In January 1894, a bulletin entitled “One Hundred American Rations for Dairy Cows”, written by Prof. F. W. Woll, was issued by the Wisconsin Experiment Station. In this bulletin the author compiles the feeding rations used in over a hundred dairies scattered from the Pacific to the Atlantic ocean. After a study of the results, he wrote as follows:—(Wis. Bulletin 38, page 46.)

"Combining all of the above 128 rations which have been fed by successful dairy farmers and breeders in the various parts of our continent we have the following average American ration, as it may be called, as against the rations published by German experimenters, and heretofore largely used in this country."

American standard ration for dairy cows.

	Dry matter.	Digestible matter.				Nutritive ratio.
		Protein.	Carbohydrates	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.		
Average for 128 herds	24.31	2.15	13.27	.74	16.16	1:6.9

"This ration is practically the same as the one published in Bulletin 33 and in our 9th report; it is believed that it will be found correct for our American conditions, except perhaps for those of the Rocky Mountains and the Pacific States. While local conditions or the business methods of farming in some places may make a ration desirable which contains more protein than this and has a narrower nutritive ratio as a consequence, we feel confident that in the large majority of cases its adoption will give satisfactory results, and that it is preferable to the German standard ration so long placed before our stock feeders as the ideal one, the nutritive ratio of which is 1:5.4. It is the result of American feeding experience; the majority of our most successful dairymen feed in the way indicated by the ration and we shall not go far amiss if we follow their example."

Later in this bulletin some calculations will be given of the rations fed at this Station and the deductions that are warranted therefrom.

Knowing the composition of the feeding stuffs which he has on hand or which he can purchase, and knowing the amounts of dry matter and digestible protein, carbohydrates and fat they each contain, the dairyman is prepared to decide how much of the different materials his herd will require, which fodders he will feed, what he will sell and what he shall buy, since he knows the amounts of protein, and other nutrients his cows will require per day during the season and the amounts of the same which a given weight of each of his fodders will supply.

CALCULATION OF RATIONS.

A dairy herd is to be fed during the winter and there is on hand on the farm the following list of materials which are worth in the market the prices indicated. The dairyman can purchase in the local markets the feed stuffs given in the latter part of the table at the prices mentioned. The problem to be solved, as an illustration of the methods used in computing rations, is to determine economical rations for the herd during the winter and incidentally whether any of the grain grown on the farm should be sold and the proceeds used to purchase commercial feeding stuffs.

FEEDING STUFFS GROWN ON THE FARM.

Clover hay at		$6.00 per ton.
Timothy hay at		8.00 per ton.
Silage at		2.50 per ton.
Shelled corn at	30c bu. or	10.70 per ton.
Oats at	22c bu. or	13.75 per ton.
Wheat at	90c bu. or	30.00 per ton.
Mangolds at		2.50 per ton.
Millet hay at		5.00 per ton.
Corn stalks at		3.00 per ton.
Oat straw at		2.00 per ton.

FEEDING STUFFS IN THE MARKET.

Linseed meal	$19.00 per ton.
Wheat bran	9.50 per ton.
Wheat middlings	10.50 per ton.
Gluten meal	17.00 per ton.
Buckwheat middlings	18.00 per ton.
Malt sprouts	15.00 per ton.
Cotton seed meal	20.00 per ton.
Pea meal	16.00 per ton.

In making the selection of the feed for his cattle the farmer will be controlled largely by the kind and quantity of coarse fodders he has on hand. Regardless of their cost, whether known or unknown, or assumed value in comparison with other feeds, these coarse fodders will form the bulk of his ration. His cows are to be used as machines for converting these products of the farm into butter. The dairyman will not consider in the first instance then, what ration he can compound that will best suit the cows from a physiological standpoint, that will make them give the largest yield of milk and butter, regardless of cost, but what ration will bring the largest net return for the forage upon his farm. In other words the dairy herd must be considered as an integral part of the general farm management and not as a separate institution whose best good is to be considered independent of the rest of the farm.

It is more than probable that the grain which the farm has produced will not fit to the best advantage into the coarse fodders to produce the best and cheapest ration. For the most part there is a ready market for this grain for cash and should it appear that some by-product, like bran or gluten meal, costing less in the market than the grain will bring, is really worth more pound for pound to supply some needed factor in the ration, he will sell part at least of the grain and buy with the proceeds some of the given by-products. In this way he will both better and cheapen his ration. The wheat, for instance, he will sell because its market price is greater than its value for cattle feed. It is more than possible that the same thing is true of part at least of his oats. Corn, on the other hand, is produced so abundantly in this country that it brings in the market a price relatively low, when its high content of nutrients is considered. The dairyman will therefore find himself seldom justified in selling corn.

It may be well at this point to compare the feeding stuffs on hand and that may be purchased as to their content of digestible nutrients and the cost of one pound of nutrients in each, at the prices assumed. Be it remembered, however, that this comparison is made with the prices assumed and that the cost of one pound of digestible nutrients here given is true alone when the prices of the different feeding materials are the same as those assumed. The method of determining the cost per pound of digestible nutrients in these feeding stuffs is simple.

Let us take oats as an instance. By reference to table 1 we see that in one pound of oats there is .091 pounds of digestible protein, .447 pounds of digestible carbohydrates and .041 pounds of digestible fat. Adding together these amounts of protein, carbohydrates and fat, there is as a result .579 pounds of digestible nutrients in a pound of oats. Multiplying these amounts by 100 and setting them down in tabular form we have this table:

	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Total digestible nutrients.	Cost of 1 pound digestible nutrients.
	lbs.	lbs.	lbs.	lbs.	
100 pounds oats	9.1	44.7	4.1	57.9	$0.0119
100 pounds bran	12.6	44.1	2.9	59.6	.008

The cost of one pound of digestible nutrients given in the last column of the table is found by dividing the value of the hundred pounds of oats, at the price assumed, $.6875, by 57.9.

In the same way the digestible nutrients and cost of one pound of digestible nutrients were calculated for bran.

Treating the other feeding stuffs in the same way we determine the cost of one pound of digestible nutrients in each.

TABLE II.

Material.	Price per ton.	Cost of one pound digestible nutrients.
Linseed meal	$19.00	$0.0139
Wheat bran	9.50	.0079
Wheat middlings	10.50	.0084
Gluten meal	17.00	.01
Buckwheat middlings	18.00	.015
Malt sprouts	15.00	.013
Cotton seed meal	20.00	.0148
Pea meal	16.00	.01
Oats	13.75	.0119
Corn meal	12.03	.0078
Clover hay	6.00	.007
Timothy hay	8.00	.0176
Silage	2.50	.0096
Mangolds	2.50	.0174
Millet hay	5.00	.0045
Cornstalks	3 00	.0041

Comparing first the coarse fodders we note that digestible nutrients cost over a cent and three quarters in timothy hay and but seven tenths of a cent per pound in clover hay. A reference to Table I shows farther that the per cent of protein in the latter is twice as great as in the former. Protein is the element in which the home grown feeds are most apt to be lacking and the one that has to be purchased usually in the form of bran or some other by-product to complete an efficient ration. It is evident, therefore, at the outset of our study of this problem, that we can hardly afford to feed timothy hay if we have abundant supply of clover. In fact, if clover hay can be purchased, at the prices named, it would be better to sell the timothy and buy clover if the supply is short.

Corn stalks and millet hay furnish digestible nutrients at small cost, but these digestible nutrients so furnished are very low in protein, and call for the purchase of relatively large amounts of by-products to supply this element. Comparing silage and mangolds, both of which are succulent fodders, we find that the former is much the more economical. Since both are produced on the farm, and neither is a readily marketable commodity, both will be fed, and such a course is advisable, since it affords variety to the ration. When, in the spring, plans are being devised for growing food for the herd the ensuing winter, the relative cost of digestible nutrients in silage and mangolds will be borne in mind and the silage will be relied upon as the chief succulent feed, and only enough of the mangolds raised to furnish the desirable variety.

Among the grains and by-products, corn meal furnishes the essential food elements more cheaply than does any other. Next in the list comes wheat bran at .8 of a cent per pound, for digestible nutrients. It so happens that a combination of corn meal and bran fits into the most common mixtures of coarse fodders most perfectly and furnishes the desired grain ration at relatively low cost. In chemical composition oats and bran are similar, the latter being somewhat richer in protein and the former in fat. At the prices assumed, one pound of digestible nutrients in whole oats is worth $.0119 and in bran but $.008, or 32 per cent less. When, therefore, bran is worth $9.50 per ton it furnishes digestible nutrients of approximately the same quality at the same price per pound that oats would furnish them if worth but fifteen cents per bushel. In other words, as far as chemical composition goes, oats at fifteen cents per bushel are of equal feeding value with bran at $9.50 per ton.

Both gluten meal and pea meal are rich in protein, and are therefore feeding stuffs which the farmers will buy to mix with corn stalks, millet hay and other coarse feeds which are poor in protein; but gluten meal contains per hundred pounds, 28.8 pounds of protein, while pea meal has per hundred pounds but 18. Both furnish digestible nutrients, at the prices assumed, at one cent per pound. As far, therefore, as total digestible nutrients are concerned, if bran is worth $9.50 per ton, both gluten meal and pea meal should be worth $12.66 to furnish digestible nutrients at the same price per pound. In the same way, counting the cost per pound of total digestible nutrients and regarding in this view of the case a pound of protein, a pound of carbohydrates and a pound of fat of equal value, we could estimate the prices at which other grains and by-products must be sold to furnish digestible nutrients as cheaply as bran at $9.50 per ton. In such a table, buckwheat middlings would be rated at $9.61 per ton, malt sprouts at $9.12, cotton seed meal at $10.63 and linseed meal, old process, at $10.78. These figures, however, would be entirely misleading as indicating the relative value of these different grain feeds for the use of the farmer. He can supply the carbohydrates and fat much more cheaply in the form of hay, corn stalks, silage and straw than he can purchase them in these expensive by-products.

A very little experience in calculating rations will emphasize the fact that protein is the one element which he will have to look for in the feeding stuffs he buys. A comparison of these by-products as to their content of protein and relative prices may give some light as to which furnishes protein most cheaply. If the price per ton be divided by the number of pounds of protein in a ton the result will be the cost of a pound of protein in the given material if the value of the other constituents be not regarded. At the prices assumed in this bulletin cotton seed meal would supply protein at $.027 per pound, gluten meal at $.0295, linseed meal at $.034, malt sprouts at $.038 and pea meal at $.044. These prices of the protein in the different materials do not give an accurate indication of the relative values of those materials as a whole, but will aid us in selecting the ones to purchase to go with our cheapest fodder, characteristically poor in protein.

Having at his command a lot of corn stalks, millet hay, clover hay and mangolds besides the silage he must choose between them the one which he will use for the basis of his ration. If sheep are kept and young stock of the cattle kind, he will naturally devote his silage to the milk cows and the bulk of the remaining coarse materials to the other stock. With the silage he will feed some kind of hay. Let us suppose that he should decide to feed thirty-five pounds of silage and ten pounds of clover hay per cow. Table 1 shows the amounts of dry matter and digestible nutrients in one pound of these materials. Multiplying these amounts of dry matter, protein carbohydrates and fat in one pound of silage by 35 and the amounts of dry matter and digestible nutrients in one pound of clover hay by ten, we have the amounts shown in the following table:

	Dry matter.	Protein.	Carbohydrates.	Fat.	Cost.
	lbs.	lbs.	lbs.	lbs.	
35 pounds silage	7.35	.315	4.00	.217	$0.0438
10 pounds clover hay	8.47	.65	3.49	.16	.03
In both	15.82	.965	7.49	.377	$0.0738

As we have seen, the combined experience of practical feeders and the investigations of the Experiment Stations have shown that a cow needs not far from 24 pounds of dry matter per day if she is in the middle of her period of lactation, is of medium size and is giving an average flow of milk. In this dry matter there should be fully 2.2 pounds of protein and as much of the carbohydrates and fat as we can get the ration to encompass and the cow to eat, which will not be far from 13 pounds of the former and from .75 to 1 pound of fat. The silage and clover hay together contain but 15.82 pounds of dry matter, the lacking 8.18 pounds must be derived from some other material. There is also a lack of 1.235 pounds of the protein. Of the grain feeds and by-products, wheat bran furnishes digestible nutrients at the smallest cost. Moreover, a reference to table 1 discloses the fact that while 10 pounds of bran will furnish more than the needed amount of dry matter, namely, 8.8 pounds, it will supply also the needed protein, 1.26 pounds. We can then make a new table, thus:

Ration 1.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Cost.
	lbs.	lbs.	lbs.	lbs.	
In silage and hay	15.82	.965	7.49	.377	$0.0738
Wheat bran, 10 pounds	8.8	1.26	4.41	.29	.0425
Total	24.62	2.225	11.90	.667	$0.1163

This ration, costing eleven and a half cents, or slightly more, per day per cow, contains enough both of dry matter and protein, but is somewhat deficient in carbohydrates.

To compare with this ration, let us make up one, using the corn and oats already on the farm, that we may know whether it is wise to sell any of this grain to buy bran. Using the silage and clover hay as before, let us first form a ration in which five pounds of a mixture of equal parts by weight of corn and oats ground together is substituted for five pounds of bran. The ration will then stand like this:

Ration 2.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Cost.
	lbs.	lbs.	lbs.	lbs.	
Silage and hay	15.82	.965	7.49	.377	$0.0738
Corn and oats, 5 pounds	4.46	.431	2.74	.18	.0344
Wheat bran, 5 pounds	4.40	.63	2.21	.14	.0213
Total	24.68	2.026	12.44	.702	$0.1295

In obtaining the cost of the corn and oats in this instance one eighth of the cost of the original grains is added for grinding.

This ration costs 1.32 cents per cow per day more than the former one. It does not necessarily follow, however, that it should not be used. The distance from market and from the mill would have to be considered. If the grinding can be done by a windmill or a cheap power on the farm it may pay better to use the corn and oats than to sell them and buy bran at the prices assumed. In the silage there is, of course, considerable corn, and it would be expected that, for the sake of variety, it would be better to use grain other than corn to supplement the ration.

Examining Table II again it is noticed that millet hay furnishes digestible nutrients so cheaply that it is probable that it could be used to advantage in the ration with silage. Fifteen pounds per day would be a fair amount to try, the ration would then be:

Ration 3.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Cost.
	lbs.	lbs	lbs.	lbs.	
30 pounds silage	6.30	.27	3.43	.186	$0.0375
15 pounds millet hay	13.70	.61	7.56	.015	.0375
	20.00	.88	10.99	.336	.075
6 pounds malt sprouts	5.42	1.18	2.17	.10	.045
Total	25.42	2.06	13.16	.436	$0.12

The silage and millet hay lack four pounds of dry matter and one and two tenths pounds of protein of conforming with the standard ration, as found below for the average sized cows of the College herd, and falls still farther below the German standard. Table I shows that six pounds of malt sprouts would furnish an ample amount of dry matter, and with it nearly enough protein to make the ration ideal. With the sprouts added the ration is as completed above and costs twelve cents per day per cow.

Remembering that gluten meal furnishes protein more cheaply than malt sprouts do, we might try five pounds of gluten meal instead of the malt sprouts. The 30 pounds of silage and 15 pounds of millet hay, with five pounds of gluten meal, would make a ration having 24.52 pounds of dry matter, 2.32 pounds of protein, 12.96 of carbohydrates and .93 of fat. Though the ration is more nearly perfect its cost is one quarter of a cent less per day.

Before deciding on the ration to be used, other combinations will be calculated in the same way with other feed stuffs to find out whether a cheaper and equally efficient ration cannot be compounded. The method of making these calculations has been sufficiently illustrated, and it will be enough to demonstrate the practicability of other combinations if the components are stated and the totals of the dry matter, protein, carbohydrates, fat and cost. Every reader of the bulletin, however, who keeps dairy cows should make an inventory of the fodders and grains he has on hand and of such materials as he can purchase in the market, should set down the market price of the latter and the selling price of the former, and with such data should compute several rations, adopting the one giving the greatest efficiency at least cost. Experience must teach the peculiarities of each feeding stuff. In the dairy literature he will find recorded the results of experiments with nearly, if not quite every feeding stuff on the list. Of this information he should avail himself and should modify his adopted ration accordingly. It may be that his cheapest ration is not available because some one component is illy adapted to the production of milk for the purpose he wants it. When fed, the ration may produce too soft butter, or too hard, or it may be that while the calculated amount of dry matter, protein and other constituents, is theoretically correct, the combination is distasteful to the cow or does not keep her bowels in their normal condition. All of these factors must be considered and given due weight in practical dairy feeding. With all the information he can obtain from bulletins or other sources, and with all the experience obtained from feeding good and poor cows through many years, it is, after all, that indefinable something that we call judgment that determines the adaptability of the ration and the production of profit from feeding cows.

With the materials in our supposed case the following combinations are suggested:

Ration 5.

Forty pounds of silage, 10 pounds timothy hay, 5 pounds of pea meal, 4 pounds of gluten meal, this ration gives the results as under:

Dry matter	24.99 pounds.
Protein	2.29 pounds.
Carbohydrates	13 47 pounds.
Fat	.83 pounds.
Cost	$0.164

Ration 6.

If 15 pounds of clover hay be substituted in this ration for the 10 pounds of timothy hay and 4 pounds of gluten meal the results will be

Dry matter	25.58 pounds.
Protein	2.23 pounds.
Carbohydrates	12.66 pounds.
Fat	.523 pounds.
Cost	$0.135

A ration nearly as efficient and three cents per day cheaper.

Still other combinations, without silage as a basis, are suggested.

Ration 7.

Corn stalks, 8 pounds; clover hay, 10 pounds; corn meal, 4 pounds; wheat bran, 10 pounds, containing

Dry matter	25.52 pounds.
Protein	2.35 pounds.
Carbohydrates	13.22 pounds.
Fat	.63 pounds.
Cost	$0.1036

A ration rather high in dry matter, but very cheap and worth trying.

Ration 8.

Or, cornstalks, 10 pounds; clover hay, 8 pounds; corn meal, 4 pounds; wheat bran, 10 pounds, containing

Dry matter	25 02 pounds.
Protein	2.26 pounds.
Carbohydrates	13.23 pounds.
Fat	.61 pounds.
Cost	$0.10

As far as indicated by the chemical composition of the feeding stuffs and the mathematical calculations based thereon, the rations to be used with feeding stuffs at the prices named will be made up of clover hay, millet hay, silage, roots, cornstalks. corn meal, wheat bran and oats and gluten meal. The wheat and timothy hay would be sold, and of the feeding stuffs in the market wheat bran, gluten meal, malt sprouts, linseed meal, or cotton seed meal would be purchased, the choice depending on the amounts of the different coarse fodders on hand.

If the supply of clover hay was sufficient, bran would be the by-product to be bought, but if it is necessary to feed up a considerable quantity of cornstalks and millet hay, cotton seed meal, gluten meal or linseed meal in the order named would be chosen because they furnish the needed protein cheaply. Cotton seed meal cannot be fed in larger amounts than 2 pounds per day per cow, a fact to be remembered in calculating the amount of protein to be derived from it.

But rations cannot be built up on mathematical rules alone. The peculiarities of the different cows, the milk yield, the lapse of the period of lactation must all be considered. The rules and methods here given are but helps to the experienced feeder. They are not to take the place of judgment and experience, but to aid them. Cattle feeding cannot be relegated to the realm of applied mathematics nor can the tyro succeed as a cow feeder by studying chemical formulæ and rules of computing rations. Given, however, a thoughtful and experienced feeder, he can, by studying the composition of feeding materials, learn how to combine them to keep up the production of his herd at less cost and by reducing the cost, increase the profit.

THE M. A. C. STANDARD RATION, FOR DAIRY COWS.

The records of the feeding and milk yields of the dairy herd at the College may be studied in reference to the average amount of dry matter, protein, carbohydrates and fat consumed per thousand pound live weight per cow per day, and thus some light may be thrown on the question of a standard ration for dairy cows suitable to Michigan conditions. The College herd has been managed not differently from other herds in the State except that the feed has been weighed as has also been the milk yield. It must be remembered in considering these records that to obtain them, it has been necessary to weigh all the coarse fodder, all the grain, and in fact everything eaten by each cow, to set down the dates of the birth of the calf, the weights of the cow at weekly intervals, and the weights of each mess of milk and its per cent of fat as shown by the Babcock test. This has involved an immense amount of labor, but it has been absolutely necessary, to make the results accurate and trustworthy.

The essential facts in the history of the cows, whose partial records are considered in the formulation of the College standard ration, are given in the following table. Since many of the cows were used in experiments which necessitated conditions modifying their yields or food consumption and since some cows calved in the spring and were nearly dry the following winter, but part of the total records at hand are available for the purposes of this discussion. It is important that the breed of the cow, the date of her birth and her yields of milk and fat in successive milking periods be set forth that a clear idea may be had of the general effect of the rations on the subsequent usefulness of the cow and that it may be farther shown that the cows were individuals of fully average merit.

TABLE III.—*Some College Cows and their Records.*

Name.	Breed.	Date of birth.	Yields of milk and fat.				
			Ending.	Length, months.	Milk, lbs.	Fat, lbs.	Butter, lbs.
Aida II	Guernsey	Jan. 12, '92	July, '95	10	3,155.9	157.94	184.26
			Sept., '96	10	6,043.8	340.65	397.42
			Aug., '97	10	5,049.6	251.87	293.84
College Pogis	Jersey	May 11, '90	Aug., '95	11	6,559.	316.26	368.97
			Oct., '96	11	11,314.71	553.06	645.23
			Aug., '97	4	4,565.9	207.91	242.56
College Pogis II	Jersey	Nov. 18, '92	Sept., '95	11	4,793.5	227.05	264.89
			Sept., '96	11	6,853.	352.36	411.08
			Aug., '97	10	6,306.4	330.96	386.14
Polly's Blossom	Guernsey	Aug. 21, '92	Nov., '95	11	5,231.7	244.66	285.43
			Mar., '96	3	1,875.1	82.52	96.27
College Dame LeBrocq	Jersey	Feb. 29, '92	Aug., '95	10	4,132.8	246.57	287.66
			Sept., '96	11	6,394.8	384.68	448.97
Cara	Red Polled	July 27, '93	Oct., '96	15	5,913.6	234.85	273.99
Oatka	Holstein	Mar. 26, '90	—— '92	--------	7,574.5	--------	--------
			Aug., '94	9	7,250.4	--------	--------
			Dec., '95	15	11,909.8	379.42	442.65
			April, '97	12	11,859.1	346.82	401.62
College Rosa Bonheur	Holstein	Feb. 6, '94	Aug., '97	12	14,171.9	453.79	529.42
Belle Sarcastic	Holstein	Jan. 18, '90	Nov., '95	19	30,514.2	915.94	1,038.60
			Aug., '97	18	29,514.77	941.31	1,098.19
Aaggie Wayne	Holstein	Nov. 10, '90	Oct., '93	--------	14,385.1	--------	--------
			Mar., '95	8	6,597.9	197.21	230.00
College Pauline Wayne	Holstein	Jan. 28, '92	Dec., '95	12	8,186.4	265.46	309.70
			Jan., '97	12	11,036.4	353.90	412.88
Houwtje D	Holstein	May 12, '88	Nov., '95	18	22,686.4	800.17	933.50
			Nov., '96	12	16,753.	570.81	665.94
Coll. Pauline America	Holstein	Oct. 31, '92	Jan., '96	14	8,216.4	258.75	301.87
			June, '97	12	7,195.0	206.04	240.40
College Houwtje	Holstein	April 18, '91	Dec., '94	--------	7,482.3	239.45	279.36
			Jan., '96	12	9,247.4	287.15	335.01

Victoria B. was a Shorthorn not belonging to the dairy herd, and her records for successive periods of lactation cannot for that reason be given. Jersey and Milla were grade cows, temporarily in the herd for use in an experiment. Their behavior was normal, however, and although their records cannot be given for the months preceding, a note was taken of their yields at the time the feeding recorded in the table below was made.

The Feed.—Silage formed the bulk of the ration. With the silage was fed a mixed hay composed of undetermined proportions of timothy and clover. Other coarse fodders, such as cornstalks, millet hay, alfalfa hay and small amounts of other fodders were occasionally used.

The grain ration has consisted of various mixtures of corn, oats, bran, linseed meal, cotton seed meal, gluten meal, and occasionally small amounts of other commercial grains and by-products. During the winter of '94-95 wheat was very cheap and limited quantities of it were fed. The main grain ration for that winter consisted of one half of a mixture of linseed meal, bran, oats and corn, in the proportion of one part of linseed meal to two of bran, three of oats, and four of corn, and one half of a mixture of bran and wheat, half and half. During the winter of '95-96 the usual grain ration consisted wholly of one part linseed meal, two of oats, three of bran and four of corn. In the winter of '96-97 the grain ration was made up of one part linseed meal, two parts corn, three of bran, and four of oats.

To give variety to the ration, roots were fed almost continuously during the winter months. These roots were for the most part mangolds, sometimes sugar beets or carrots.

The composition of the feeding stuffs being known, and the amounts fed daily having been carefully weighed, it was not difficult to determine the composition of the average daily ration of the various cows. The method of feeding differed somewhat from that generally used by experiment stations, but was the one adopted after considerable thought, and is one which is approved by farther experience.

The coarse fodders are weighed daily to each animal, the quantities given being gauged by the judgment of the feeder. Weights are taken on scales that read to half a pound. Variations of a less quantity in these cheap and relatively heavy fodders are not material. It was found, after trying the method for a year with the large herd, that to weigh the grain daily for each cow involved so many delicate weights and permitted so many errors that some other scheme had to be devised to insure accurate results. For the years 1895, 1896 and 1897, therefore, a box large enough to hold two hundred pounds of the grain mixture has been provided for each cow. Into this box there is weighed weekly enough grain to more than last a week. At the close of the week the box and the grain remaining in it are weighed and that weight subtracted from the weight of grain and box at the beginning of the week. In this way the amount of grain consumed by the cow during the week is accurately determined. This method is not applicable to experiments whose results depend upon a knowledge of the amount of grain consumed each particular day, but recommends itself to conditions where the record of food consumption for a long time is contemplated.

Analyses of the feeding materials were made by the chemical department of the Station not infrequently. To bring together many of these analyses the following table is given:

Composition of Michigan feeding stuffs, (original analyses).

No.		Dry matter.	Protein.	N. free extract.	Crude fiber.	Fat.	Ash.
1	Oat and pea silage	35.43	6.25	12 20	13.00	1.15	2.82
2	Lathyrus silage	21.06	5.31	6.59	6.47	1.04	1.65
3	Lathyrus in full bloom	19.94	5.58	7.34	5.25	.48	1.27
4	Millet silage	42.90	3.18	19.51	15.10	.73	4.38
5	Silage—Dec. 10, '95	31.38	-------	-------	-------	-------	-------
6	Jan. 13, '96	27.65	-------	-------	-------	-------	-------
7	Jan. 20, '96	22.32	-------	-------	-------	-------	-------
8	Feb. 4, '96	26.08	-------	-------	-------	-------	-------
9	Feb. 15, '96	21.74	-------	-------	-------	-------	-------
10	Feb. 25, '96	21.99	-------	-------	-------	-------	-------
11	Mar. 4, '96	20.49	-------	-------	-------	-------	-------
12	Mar. 17, '96	17.95	-------	-------	-------	-------	-------
13	Mar. 24, '96	20.37	-------	-------	-------	-------	-------
14	Dried pasture grass	36.05	8.14	14.81	7.94	1.68	3.48
15	Timothy hay	82.30	6.43	35.45	33.09	1.56	5.77
16	Common millet seed	85.72	13.96	53.54	11.08	4.39	2.75
17	Hungarian seed	80.91	15.75	50.15	8.20	3.87	2.94
18	Fodder corn—Aug. 24, '96	16.68	2.85	15.56	6.05	.72	1.46
19	Aug. 27, '96	23.57	2.08	14.29	5.42	.67	1.12
20	Aug. 31, '96	28.49	1.19	18.54	5.97	.91	1.12
21	Sept. 1, '96—very thick	30.75	.98	19.79	8.03	.54	1.71
22	Rows 14 inches	32.24	1.06	21.47	7.62	.65	1.39
23	Rows 28 inches	34.31	2.55	22.95	6.24	1.22	1.36
24	Rows 42 inches	30.06	2.01	19.57	6.25	.96	1.27
25	Rows 42x42	29.18	2.02	19.18	5.62	1.04	1.23
26	Sorghum—Sept. 2, '96	19.91	1.10	11 25	5.60	1.16	1.03
27	Corn—Sept. 16, '96	34.62	2.34	21.66	7.77	1.29	1.56
28	Silage—Dec. 1, '96—cut Sept. 16	25 31	2.13	13.73	6 84	.98	1.72
29	Cut Sept. 7	15.40	1.29	7.96	4.65	.56	.93
30	Cut Aug. 31	16.98	.68	10.73	4.11	.59	.87
31	Cut Aug. 27	21.74	1.03	12.69	6.00	.77	1.24
32	Kaffir corn—silage	24.09	.87	13.23	7 62	.79	1.57
33	Sorghum silage	19.97	1.36	10.27	6.74	.65	.97
34	Corn silage—Jan. 27, '97	22.31	1.83	12.81	5.86	1.84	.96
35	Beans	67.80	21.81	36.08	2.64	3.09	4.18
36	Fodder corn—Aug. 11, '97	17.31	2.23	8.62	4.76	.32	1.38
37	Aug. 27, '97	20.87	2.02	12.60	4.51	.56	1.18
38	Sept. 7, '97	27.49	2.75	17.61	5.00	.77	1.33
39	Sept. 15, '97	34.86	3.02	23.28	6.14	1.05	1.35
40	Sept 22, '97—rows 7 inches	35.21	1.41	23.51	7 99	.57	1.72
41	Rows 14 inches	37.69	2.12	24.70	8.14	.79	2.07
42	Rows 42 inches	40.50	3.06	28.39	6.31	1.27	1.47
43	Salzer's fodder corn—Sept. 22, '97	30.62	2.41	20.17	5.82	.78	1.45

While the composition of the grain ration was fixed in the office of the Farm Department of the Experiment Station, the amount to be fed each day to each cow was left to the judgment of the expert herdsman. This plan was inevitable. No cow wants day after day the same amount of food nor even the same mixture. When the weather is cold and keen, her appetite is more vigorous, even if she is kept in a relatively warm but well ventilated barn, than on a warm and murky day. The proportion of coarse fodders to grain may profitably be increased on such occasions. The quantity, therefore, both of the coarse fodders and of the grain feed and by-products was left entirely to the judgment of the man who fed the cows and who adjusted the quantity to the milk yield and the condition of the bowels.

It is interesting to note how nearly the daily ration thus prepared for a dairy herd by an expert feeder compares with the standard proposed in Germany or recommended by Prof. Woll.

In the tables that follow, there is recorded the average daily ration for several cows of the herd. The records of such cows only are used for this table as were not undergoing experiments which involved sudden or unusual changes of diet. The average daily ration is given for the month indicated. In nearly every case silage formed the basis of that ration. To obtain the daily ration for the month the amount of silage consumed during the month was divided by the number of days in the month. It would naturally be expected that a large cow would eat more than a small one, and it would hardly be fair to compare the work of different cows on the basis of the total amount of feed consumed per day. For that reason the table gives not the average amount of silage consumed per day, but the average amount of silage consumed per day *per thousand pounds live weight.* In the same way the amount of mangolds or hay or grain set down in the table is determined; first all that the cow ate of the given material in the month is found by adding together the amounts fed daily and the sum is divided by the number of days in the month and this quotient by the weight of the cow, expressed in thousand pounds or decimals of a thousand pounds, so that the amount set down in the table represents the average daily ration per thousand pounds live weight for the given month. Necessarily, the grain ration varied from month to month in composition and recalculation was necessary even when the grain ration for two succeeding months was identical in amount.

With both the amount and composition of each component of the ration known it was easy to calculate the dry matter, protein, carbohydrates and fat consumed daily.

There is, then, in the table, the actual amount of dry matter, of digestible protein, digestible carbohydrates and digestible fat in the average daily ration per thousand pounds live weight of the cows mentioned, but unless some indication was given of the efficiency of the ration, this data would not be sufficient to form a basis of an opinion as to its merits. The effect of the ration is measured by the amount of butter fat yielded daily and the changes in live weight. The amount of butter fat secreted by a cow varies greatly from month to month. It is almost invariably greater soon after the birth of her calf and gradually decreases as her milking period progresses. After the column giving the average daily fat yield for the month, the figure in the next column indicates the number of the particular month in the milking period. In the next column is given the average weight of the cow for the month.

To illustrate, the first name on the list of the smaller cows is Aida II. The first month for which her work is recorded is December, 1895. Her average daily ration *per thousand pounds live weight* for the month was 30 pounds of silage, 15 pounds of mangolds, 2 pounds of hay and 19 pounds of grain. In this ration there was 27.51 pounds of dry matter, 2.60 pounds of protein, 15.03 pounds of digestible carbohydrates and .96 pound digestible fat. The next column shows that her average daily yield of fat *per thousand pounds live weight* was 1.07 pounds. The next column shows that this month of December was the first month after the birth of her calf and therefore the first in this period of lactation, as it is called, and finally the last column shows the average weight of the cow for the month. The cows were weighed weekly and the amount stated is the average of the weekly weights. By comparing these weights for successive months it is possible to determine whether the cow was gaining or losing weight.

It is important to know in what part of the period of lactation the given month is, because the amount of feed eaten in proportion to the fat yielded is much less during the earlier months of the milking period than it is later and where the yields of several cows are to be compared this point must be noted.

DAILY RATIONS PER ONE THOUSAND POUNDS LIVE WEIGHT.

Smaller cows.

Months.	Silage.	Mangolds.	Hay.	Grain.	Dry matter.	Protein.	Carbo-hydrates.	Fat.	Daily fat.	Month after calving.	Weight.
Aida II:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.
Dec., 1895	30	15	2	19	27.51	2.60	15.03	.96	1.07	1	865
Jan., 1896	38	15	2	18	29.31	2.56	15.42	.97	1.42	2	915
Feb., 1896	37	15	2	18	26.97	2.56	15.32	.95	1.42	3	936
Mar., 1896	31	15	1	18	24.50	2.46	14.21	.91	1.31	4	969
Apr., 1896	32	15	1	18	24.70	2.47	14.32	.92	1.33	5	977
Dec., 1896	31	15	4	14	24.03	2.21	13.04	.82	1.34	2	975
Jan., 1897	44.5	14.8	3	14	25.52	2.26	13.90	.88	1.23	3	1,007
Feb., 1897	44.5	14.8	2	13.96	24.72	2.23	13.49	.88	1.22	4	1,025
Mar., 1897	40	14.8	2	14.7	24.50	2.27	13.36	.88	1.09	5	1,063
College Pogis:											
Jan., 1895	16*	------	6	8	18.99	1.34	10.66	.38	1.18	4	954
Feb., 1895	24	------	6	8	17.17	1.25	9.63	.44	1.10	5	945
Mar., 1895	20†	------	6	8	18.43	1.95	12.48	.54	.95	6	956
Dec., 1895	31	11	2	18	25.25	2.19	14.79	.73	1.70	2	1,070
Jan., 1896	36	15	2	18	26.56	2.36	15.61	.77	1.82	3	1,086
Feb., 1896	36	15	2	18	26.56	2.36	15.61	.77	1.80	4	1,130
Mar., 1896	35	15	2	18	26.34	2.35	15.50	.76	1.80	5	1,150
Apr., 1896	35	15	1	18	25.50	2.31	15.08	.75	1.66	6	1,144
College Pogis II:											
Dec., 1895	37	17	2	21	31.65	2.71	17.54	.87	1.60	2	842
Jan., 1896	41	17	2.5	21	32.94	2.75	18.13	.94	1.60	3	880
Feb., 1896	33	15	2	18.4	26.28	2.36	15.46	.76	1.32	4	925
Mar., 1896	35	16	1	18.4	25.97	2.37	15.34	.77	1.26	5	910
Apr., 1896	34	16	2	17	25.44	2.26	14.93	.74	1.21	6	960
Dec., 1896	31	15	9	14	27.70	2.40	14.92	.87	1.63	1	975
Jan., 1897	44.5	14	3	13.6	25.17	2.21	13.70	.87	1.50	2	1,025
Feb., 1897	45	14.8	2	13.6	24.50	2.19	13.37	.86	1.30	3	1,025
Mar., 1897	45	15	2	11.5	22.66	1.95	12.39	.78	1.18	4	1,050
Polly's Blossom:											
Jan., 1896	37	14	3	12.5	24.36	1.96	10.51	.75	1.00	1	832
Feb., 1896	37	17	2.5	17	28.19	2.48	15.13	.92	1.13	2	840
Mar., 1896	33	17	2	20	27.72	2.75	16.00	1.00	1.17	3	876

Smaller cows - Concluded.

Month.	Silage.	Mangolds.	Stalks.	Hay.	Grain.	Dry matter.	Protein.	Carbo-hydrates	Fat.	Daily fat.	Month after calving.	Weight.
College Dame Le Brocq:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.	lbs.		lbs.
Dec., 1895	32	15	----	1	15.8	22.92	2.06	13.52	.68	1.14	4	1,027
Jan, 1896	36	15	----	2	12.7	23.70	1.82	12.63	.62	1.11	5	1,056
Feb., 1896	35	15	----	2	12.7	21.64	1.80	12.61	.62	1.11	6	1,086
Mar., 1896	34	15	----	1	11.3	19.35	1.62	11.34	.56	1.02	7	1,112
Apr., 1896	34	15	----	1	10	18.20	1.49	9.64	.53	1.11	8	1,130
Dec., 1896	31	14	----	6	12.3	25.16	1.98	13.33	.74	1.36	2	1,076
Jan., 1897	44	14	----	4	12.6	24.93	2.14	14.12	.82	1.00	3	1,154
Feb., 1897	45	15	----	2	11.2	22.32	1.86	12.73	.75	.70	4	1,190
Cara:												
Jan., 1897	32	15	----	3	12	22.72	1.87	12.07	.714	1.12	1	1,000
Feb., 1897	30	15	----	2	14	21.62	2.04	12.70	.77	1.70	2	990
Mar., 1897	30	17	----	2	14	21.82	2.06	12.83	.77	1.04	3	1,005
Apr., 1897	30	15	----	2	13	20.94	1.95	12.04	.73	1.07	4	1,013
College Dame Le Brocq:												
Jan, 1895	25*	-----	----	6	8	22.82	1.50	12.67	.34	.75	4	864
Feb., 1895	24	-----	----	6	8	19.40	1.32	9.73	.38	.80	5	855
Mar., 1895	20†	-----	----	6	8	19.14	1.95	12.49	.51	.76	6	878
College Chemeaula:												
Feb., 1896	27	15	----	3	15	22.86	2.01	13.38	.64	1.10	1	1,066
Mar., 1896	28	15	----	1.3	18	24.30	2.27	14.40	.72	1.17	2	1,137
Jersey:												
Jan., 1896	------	14	12	5	10	17.54	1.45	10.28	.44	.91	6	800
Feb, 1896	----	8	9	5	9	15 31	1.26	8.85	.38	.92	7	775
Mar., 1896	------	7	2	8	10	16.76	1.59	9.55	.39	.89	8	750
Milla:												
Jan., 1896	------	18	11	6	13	21.14	1.82	12.56	.53	.90	2	945
Feb., 1896	------	8	11	6	11	18.45	1.52	10.67	.46	1.06	3	950
Mar., 1896	------	10	3	12	13	23.32	1.88	13.31	.52	.94	4	950
Average	29.82	12.85	1	3.29	14 12	23.57	2.06	12.50	.89	1.21		

* Millet silage.
† Oat and pea silage.

Cows nearly dry.

Month.	Silage.	Stalks.	Hay.	Grain.	Dry matter.	Protein.	Carbo-hydrates.	Fat.	Daily fat.	Month after calving	Weight.
College Houwtje:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.
Dec., 1896	27	10	------	6	14.95	1.02	7.72	.47	.4	8	1,457
Jan., 1897	33	8	------	7	15.20	1.17	8.62	.53	.4	9	1,484
Feb., 1897	33	7	------	6.3	14.32	1.08	8.12	.492	.34	10	1,479
Mar., 1897	33	9	------	6.5	15.00	1.12	8.50	.51	.4	11	1,512
Apr., 1897	33	3	2	6	14.68	1.08	8.09	.47	.4	12	1,509
College Pauline Wayne:											
Dec., 1896	36	8	------	8	18.51	1.31	9.49	.58	.36	11	1,402
Jan., 1897	36	12	------	9	20.45	1.47	10.61	.64	.28	12	1,458
College Pauline America:											
Dec., 1896	33	7	------	4	13.95	.83	6.93	.40	.2	7	1,494
Jan, 1897	33	8	------	5	15.10	.94	7.59	.44	------	8	1,523
Feb., 1897	33	7	------	8	15.82	1.27	9.01	.53	------	9	1,565
Mar., 1897	33	6	------	4	12.04	.91	6.78	.39	------	10	1,599
Apr., 1897	30	------	2	5	12.37	.90	6.88	.40	------	11	-----
Average	32.75	7.08	.33	6.23	15.20	1.09	8.20	.49	.23		

Larger cows.

Month.	Silage.	Mangolds.	Stalks.	Hay.	Grain.	Dry matter	Protein.	Carbo-hydrates.	Fat.	Daily fat	Month after calving.	Weight.
Oatka:	lbs	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.	lbs.	lbs.		lbs.
Jan., 1895	33	------	----	3	10	19.95	1.42	10.46	.53	1 06	4	1,200
Feb., 1895	33	------	----	3	10	19.95	1.42	10.46	.53	1.09	5	1,200
Mar., 1895	33	------	----	3	10	19.95	1.42	10.46	.53	.90	6	1.200
Apr., 1896	34	29	----	.5	19	27.05	2.41	16.13	.79	1.30	1	1,188
Dec , 1896	26	------	7	------	7	14.77	1 09	7.66	.456	.66	9	1,269
Jan., 1897	38	------	9	------	8	19.90	1.33	9.86	.66	.53	10	1,374
Feb., 1897	38	------	7	------	7	18.49	1.20	9.04	.611	.3	11	1,237
College Rosa Bonheur:												
Dec., 1896	28.7	18	----	4.2	11.9	21.67	1.95	11.82	.72	.98	4	1,364
Jan., 1897	38.5	12	----	1.6	11.3	20.46	1.82	11.17	.71	.96	5	1,478
Feb., 1897	40	20	----	1.3	11.0	21 09	1.88	11.62	.73	.98	6	1,491
Mar., 1897	40	18	----	1.3	11.2	21.09	1.86	11.62	.74	.95	7	1,539
Belle Sarcastic:												
Jan , 1895	23.80	25.3	----	1	12.70	21.41	1.95	12.00	.61	1.13	10	1,540
Feb., 1895	24.68	18.4	----	1	11.58	23.60	2.00	12.80	.63	1.04	11	------
Mar., 1895	25.00	27.6	----	4	12.32	24.00	2.30	12.82	.69	1.00	12	------
Apr., 1895	25.50	32.0	----	3	10.10	24.26	1.90	10.59	.57	.98	13	1,600
Mar., 1896	22.6	25.2	----	2	14.10	20.85	2.05	12.16	.74	1.42	1	1,369
Apr., 1896	27.6	29.5	----	.6	15.30	23.37	2.32	13.78	.837	1.37	2	1,458
Dec , 1896	30	20	----	5	13.33	24.4	2.19	13.28	.80	1.08	10	1,463
Jan., 1897	38.7	20	----	5	13.34	26.2	2.27	14.27	.86	1.04	11	1,500
Feb., 1897	40	20	----	4	12.00	23.8	2.05	13.01	.79	1.01	12	1,520
Mar., 1897	38.7	19	----	3	12.40	23.73	2.05	12.63	.79	.97	13	1,530
Aaggie Wayne:												
Jan , 1895	26	------	----	6	8	19.48	1.31	9.73	.40	.56	6	1,266
Feb , 1895	33	------	----	5	8	20.80	1.73	11.50	.42	.61	7	1,284
Mar., 1895	25*	------	----	7	8	25.46	2.21	14.15	.48	.61	8	1,290
College Victoria B.:												
Jan., 1896	33	13	----	1.5	19	17.70	1.40	10.23	.503	.84	3	1,220
Feb., 1896	33	13	----	1.5	9	17.70	1 40	10.23	.503	.76	4	1,270
Mar., 1896	30	13	----	1	11	17.51	1.54	10.30	.515	.71	5	1,300
College Pauline Wayne:												
Mar., 1896	33	20	----	2	19	27.28	2.48	16.10	.79	1.33	2	1,166
Apr., 1896	28	25	----	1	19	25.43	2.43	15.20	.76	1.50	3	1,203
Mar., 1897	31	------	----	2	14	20 39	1.92	11.65	.74	1.08	1	1,293
Apr., 1897	38	------	----	2	13	21.07	1.87	11.93	.75	1.08	2	1,314
Houwtje D.:												
Jan., 1895	-------	------	----	------	--------	21.90	2.14	12.97	.62	1.00	9	1,600
Feb., 1895	-------	------	----	------	--------	21.44	1.70	11.03	.53	.90	10	------
Mar., 1895	45.6†	41.2	----	3.4	14	21.44	1.70	11.03	.53	.90	11	------
Apr., 1895	-------	------	----	------	--------	19.56	1.56	10.81	.50	.77	12	------
Dec., 1895	23.75	13	----	2.6	13.33	22.21	2.01	14.39	.80	1.35	1	1,448
Jan., 1896	40.3	28.2	----	2.8	15.73	27.24	2.48	15.70	.93	1.41	2	1;543
Feb., 1896	40.2	34.9	----	2.2	14.80	26.40	2.41	15.37	.90	1.31	3	1,601
Mar., 1896	36	33	----	1.3	12.90	22.98	2.09	13.37	.79	1.28	4	1,624
Apr., 1896	34	34	----	.5	12.10	21.17	1.97	12.41	.74	1.25	5	1,662
Jan., 1897	47	20	----	5.5	12.73	27.25	2.25	14.80	.876	1.42	2	1,512
Feb., 1897	40	18	----	3	10.00	21.40	1.79	11.70	.75	1.50	3	1,500
Mar., 1897	50	18	----	2.5	12.50	25.59	2.15	13.88	.86	1.23	4	1,558
Average	34 75	18 41	.5	2.5	12.15	22 11	1.89	12.23	.67	1 027	----	------

* Ration for the four months.
† Oat and pea silage.

There is given in the table the records of fifty-two separate months for the cows weighing about a thousand pounds, and forty-three months for the larger cows. Environed as these records are by every precaution to secure accuracy and fullness of detail, the net result, the general average, is here presented as a standard ration for Michigan conditions.

M. A. C. standard rations.

	Dry matter.	Digestible protein.	Digestible Carbohydrates.	Digestible fat.	Daily fat.	Average month.	Average weight.
	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.
1,000-pound cows	23.57	2.06	12.50	.89	1.21	3.8	982.8
1,400-pound cows	22.11	1.89	12.23	.67	1.027	6.	1,396.68
Dry cows	15.20	1.09	8.20	.49	.23	9.8	1,373.5

The nutritive ratio of the standard ration suggested for the thousand pound cows is 1 : 7.1, that of the larger cows 1 : 7.21, and that of the cows in the very latest months of the period of lactation is much wider, being 1 : 8.53.

The tables from which these feeding standards were derived, page 90, conclusively demonstrate the limitations of the use of the feeding standards. They show that it is entirely wrong to assume as Wolff does to set up a stated amount of dry matter and of protein as correct for a cow of a given weight, or to graduate the amount of dry matter and of protein, which a cow should receive, by her live weight alone. One cow has a greater capacity to consume, digest, assimilate, and economically utilize food than another of the same weight. Again, the same cow requires a different amount of dry matter at one time than at another. In the early months of the period of lactation, when her yield is at the maximum, she requires a much larger amount of feed than later, when the draft upon her body for milk constituents, is lessened by the smaller yield. Take the case of Aida II, for instance. In January, 1896, although weighing but 915 pounds, her daily yield of fat was 1.42 pounds. Her average daily ration for the month supplied 29.31 pounds of dry matter per thousand pounds live weight, containing 2.56 pounds of protein, 15.42 pounds of carbohydrates, and .97 pounds of fat, with a nutritive ratio of 1 : 6.9. On this ration the cow continued her maximum yield through the month, and at the same time made a gradual gain in weight. The watchful eye of the feeder noted this fact, and slightly reduced the amount of dry matter in the ration. This was accomplished without changing the weight of the materials fed, but by feeding silage with a much lower per cent of dry matter. The dry matter fed per day to the cow was kept considerably above the standard to warrant the large yield of fat, during the five early months of the period of lactation.

Standing by her side was a mature Jersey cow, College Pogis, that had a tendency to lay on fat. She was giving a large flow of milk and was in January, 1895, in the fourth month of her milking period. Her ration was below the standard recommended. Her weight remained practically constant and her yield of fat gradually declined, as was to be expected from the lapse of the period of lactation. During the next winter her flow of milk and yield of fat daily was promising at the outset, and she was given 25 to 26.5 pounds of dry matter per day, with 2.36 pounds of protein. Her daily yield of fat kept constant for the three months of winter at 1.8 pounds or slightly more than 2 pounds of butter per day. The grain ration was kept up during the summer, and by October the cow had made the phenomenal yields of 11,314.71 pounds of milk and 553.06 pounds of fat. It would have been sheer folly to measure her feed during the early months of her period of lactation by any standard based upon live weight alone or derived from the average feeding of average cows.

Still more remarkable is the consumption of dry matter and protein of College Pogis II during the winter of 1895-96. Here we have a cow that weighed in January but 880 pounds, who was gaining in live weight because still young and who was turning out regularly nearly 2 pounds of butter a day. She required on the average for a whole month over 32 pounds of dry matter *per thousand pounds of live weight* per day, containing 2.75 pounds of protein. The cow weighed but 880 pounds, and this 880 pounds was made up largely of digestive organs, lungs and udder. In proportion to her live weight she could consume and economically utilize a very much larger amount of feed than could an animal with a massive frame and relatively small per cent of viscera and udder.

A study of the tables shows conclusively that an expert feeder varies the size of the ration, not according to the weight of the cow alone or primarily, but according to her capacity to receive and her ability to yield, and that, with the same cow, the ration is modified as the period of lactation advances, to conform to the requirements of the system.

What is true of the dry matter is true of the digestible protein. Where a cow is secreting a large amount of milk containing from one to as high as two and one half pounds of dry casein per day, her food must be relatively much richer in protein than when she has not this demand upon her system to supply. The food requirements of the system to sustain the vital functions remain comparatively constant. To these requirements is superadded, in the periods of greatest milk yields, the demand for the butter and cheese in the milk. Protein is required not only to supply the casein of the milk, but to insure that active vitality of the whole nervous system which is involved in butter production. A farther discussion of the subject is not necessary to properly emphasize the fact that not only must a larger, but a richer ration as well, be given to a cow when giving a large yield than when comparatively dry.

As to the digestible fat, economic considerations demand that such a combination of foods be made, to furnish the requisite dry matter and protein, as will furnish at the same time fully .89 pounds of digestible fat per day for the smaller cows. But no definite amount of fat can be prescribed in the ration, first, because the word fat in this connection includes within its meaning many dissimilar substances. A pound of digestible fat derived from silage or green fodder is a very different thing from a pound of digestible fat derived from linseed meal or any of the by-products. Again, using the feeding stuffs grown upon the farm for the largest practicable share of the ration it would be difficult to propose an economical combination that would not furnish more digestible fat than the standard of either Wolff or Woll calls for.

It is evident from a consideration of all the facts in the case, that a standard ration cannot be used as a fixed rule in determining the amount or kind of feeding stuffs that should be given a certain cow at a certain time. It can supplement and partially guide the judgment of the feeder, but it cannot take the place of judgment. Up to the present time no advice seems better supported by experimental evidence and more to the point than that of Prof. Julius Kühn in his article on "Feeding Standards for Domestic Animals" on page 11, Vol. 4, Experiment Station Record. He says: "For milch cows it is advisable first of all to determine the quantity of nutrients which represents the minimum requirements per thousand pounds live weight of the animals; that is, the quantity which covers the needs of the cows which are dry or nearly dry, and which while producing little or no milk are usually more or less advanced with calf. This minimum amount may be designated as the *basal ration.* It will naturally be more liberal for breeds of high productive capacity and those which keep up their milk yield well in the latter part of the lactation period and only go dry a short time, than for those of inferior milking qualities. For the latter the basal ration need not contain more than 1.5 to 1.7 pounds of digestible albuminoids, while with the former up to 1.8 pounds, and. with breeds of exceptionally high capacity even more will be needed."

A sufficient number of records are not submitted in the third division of the table, which gives the food consumption of the cows nearly dry, to warrant the statement of a definite conclusion. In each case there is a very evident increase in live weight, as there should be, when cows are approaching parturition. It is significant that the amount of digestible carbohydrates suggested by our cows does not vary greatly from the requirements suggested by Kühn in a part of the article following the section quoted, while the digestible protein is very markedly less in the case of the Michigan cows. The fact that our cows gained regularly in live weight is good, but perhaps insufficient evidence that the ration here suggested is a sufficient basal ration to be used as Kühn suggests, as representing the amounts of dry matter and digestible nutrients required by the cow to sustain the vital functions.

Whenever the ration is to be calculated for a growing cow in the flush of the early months of the milking period, the feeder will fix in his mind the proper standard ration having regard to the feeding capacity of the cow, her past history, the quantity of milk and fat she is secreting, and finally her size.

While the reason may not be altogether clear, the work of the cows points to the strong probability that a less amount of dry matter should be fed larger cows per thousand pounds live weight than smaller ones. This fact cannot be adduced from the feeding standard suggested above and the facts submitted to sustain it, because, while the 1400 pound cows require but 22.11 pounds of dry matter and the 1000 pound cows 23.57, the former were on the average in the sixth month of the milking period while the latter were at the beginning of the fourth. Between the fourth and sixth months a considerable fall in the milk production might be expected, and a corresponding decrease in the food supply would take place. This decrease in the food supply by reason of the fall in yield would at least partly account for the lower weight of dry matter and digestible nutrients reported by the 1400 pound cows.

To quote again from Kühn's article: "To feed an animal highly during the most productive part of lactation pays well, but to feed the entire herd equally well, without regard to individual production, can prove remunerative only when in addition to yielding milk the cows are to be fattened. Otherwise such feeding results in a great waste of food, is not infrequently the cause of the low profits in dairying and makes the barn yard manure expensive."

Recognizing the just limitations of the application of the feeding standard the daily ration of 23.57 pounds of dry matter 2.06 pounds of digestible protein 12.50 pounds of digestible carbohydrates and .89 pounds of digestible fat is suggested by the College herd, for cows in the third and fourth month of the period of lactation giving a good full yield of milk and butter. A knowledge of the feeding standard and the methods of computing rations is by no means all that there is of skillful cow feeding. That art is one which cannot be acquired without long experience in the stable, and one which involves the exercise of well trained powers of observation and, above all, well ripened judgment.

It is evident that the standard ration takes no cognizance of the relative money values of the various feeding stuffs. The practical feeder has to approach the question of what shall constitute his ration very largely from that side. He considers primarily not what combinations of food will cause his herd to yield the most butter, but what combinations he can bring together most economically, and by what combinations his cows will return the most net profit from the materials which his farm produces. This fact has been sufficiently illustrated in the preceding section of the bulletin relating to the computation of rations.

The standard ration fails to recognize the peculiarities of different feeding stuffs in the matter of their specific effects upon the quality of the butter produced or upon the health and condition of the cow. Some fodders, though showing a very high content of digestible nutrients, are nearly worthless because cows do not like them or because they seriously impair the quality of the products. It is not enough, therefore, to report the relation between the quantity of butter produced and the quantity of food consumed, when new forage plants are under discussion, the quality of the products and the relation of the material to the appetite of the cow must also be given, to round out and complete the proper history of the experiment. A discussion of some of the peculiarities of a few of the feeding stuffs used at the Station therefore naturally follows:

DISCUSSION OF FEEDING STUFFS.

Silage.—In keeping a record of the consumption of dry matter per day per cow the most troublesome factor has been the silage. On page 88 it is shown that, in the winter of 1895-96, the silage at the top of the silo contained much less water than that at the bottom, and that the per cent of dry matter varied continually. It is hard, therefore, to construct a table of fodder analyses that will fairly represent the composition of a given sample of silage at a given time on account of this great variability of the moisture content. The average per cent of dry matter in the nine samples analyzed in the early months of 1896 was 23.33. Where the silage was cut before the corn was fully mature and put in small silos the per cent of dry matter was very low as shown by the samples taken December 1, 1896.

Corn silage was used as the basis of the ration for the three years in which the complete dairy records have been kept. The butter made from the milk of the silage fed cows was of excellent quality, of the right consistency and body and free from any unpleasant flavors that could be traced to the silage. This was true although no special pains were taken to ventilate the barn prior to milking.

The cows were universally fond of the silage, and would eat it to the full amount allowed. Very little, if any, refuse was left in the mangers, the whole corn plant seeming to be consumed. No experiments have been undertaken at this Station to determine the relative values of field cured corn fodder and silage. That matter has, however, been so thoroughly studied in other states that conclusions seem to be well established. It has been found by a series of accurate experiments that the dry matter of silage is slightly more digestible than that of field cured corn fodder; that the losses in the silo are less than in field cured fodder when treated in the usual way; that an acre of corn will produce slightly more butter when stored in the silo than when field cured, and finally that an acre of corn can be put in the silo for approximately the expense involved in handling by the older methods. Our long experience demonstrates the practical value of the silo.

Early Amber Sorghum.—For the past few years this station has joined with those in other states in the investigation of new forage crops which it was hoped might take the place of corn or supplement it. Among these new forage crops sorghum and Kaffir corn have been urged upon the public. In 1896 a plot of a half acre was planted to sorghum for comparison with Kaffir corn and "Salzer's Superior Fodder Corn." The seed was planted in hills 18 inches apart in rows three feet apart, on the 5th of May. The soil was a sandy loam, heavily manured the fall previous. The plot was cultivated with a Breed's weeder May 14th, and frequently later during the season with a two horse cultivator. Although germination was much retarded by a cold, wet spring the sorghum grew rapidly during the summer and was, as far as could be judged by persons inexperienced in growing the crop, ready for harvest by September 1st. On that date the plot was cut, samples taken for analysis, and the entire yield put in the silo.

On the same day the adjoining plot of Salzer's fodder corn, which had been planted in hills 18 inches apart, in rows three feet apart, May 7th, and cultivated on the same dates and in the same manner as the sorghum, was also harvested and put in the silo.

The analyses of the sorghum and of the Salzer's improved fodder corn are given as numbers 21 and 27 in the table on page 88. The yields per acre of the two plots are given in the following table:

	Sorghum.	Silage corn.
	lbs.	lbs.
Green fodder	38,676.	29,684.
Dry matter	7,700.39	8,655.85
Protein	425.43	736.16
N. free extract	4,254.36	5,734.95
Crude fiber	2,169.72	1,753.54
Fat	448.64	311.68

As far as the yield per acre is concerned, the sorghum excelled the silage corn in total green fodder, but when the water was driven out, the yield of dry matter per acre was much greater in silage corn. The yield of protein by the silage corn was 310.73 pounds per acre more than was produced by the sorghum, a difference of 73 per cent.

It is only in the crude fiber and in the fat, which includes a large amount of the green matter of the leaves, that the sorghum excels the silage corn.

The silage was fed toward the spring of 1897, and the significance of the chemical analysis was shown by the cattle. While the silage from the corn was eaten up clean, that from the sorghum was picked over and the woody stems rejected. The total weight of sorghum silage did not shrink in the silo in gross weight in any greater proportion than did the corn silage, and, as is shown by a comparison of analyses 27 and 34, on page 88, the chemical composition of either sorghum or fodder corn was but little changed by keeping in the silo.

The silage was fed to the general herd in January, 1897. The five cows, Houwtje D, Aida II, College Pogis II, College Rosa Bonheur, and Belle Sarcastic, yielded for the week ending January 13th, 39.18 pounds of butter fat; for the week ending January 20th, when they were fed on the sorghum silage, 39.06 pounds of fat; for the week ending January 27th, when they were fed on fodder corn silage, 40.15 pounds of fat, and for the next three weeks, when fed on corn silage, the grain ration being constant throughout, 39.24 lbs., 37.88 lbs. and 37.74 lbs. As far as was observed the cows ate the sorghum silage with as much avidity as the corn silage, except that they rejected the woody stems.

Sorghum fodder grown in another field was shredded and fed. No careful experiments were conducted on the point, but it was noticed that the cows rejected a larger proportion of the stems of the sorghum, notwithstanding its content of sugar, than they did of the shredded corn fodder fed at about the same time.

Sorghum shows at no point, superiority to corn as a forage crop. On the other hand, its low yield of protein and its harsh, woody stems go far toward condemning it as a substitute. Our experiments do not warrant us in recommending the crop in any locality where Indian corn can be grown. An acre of the latter will produce nearly as much protein as an acre and three-quarters of the former, and will at the same time yield fully twelve per cent more starch, sugar and other soluble carbohydrates. More extended feeding experiments must be conducted before the relative feeding values of these two forage crops can be fully determined, but as far as the trials already conducted at this station go, they show that a larger proportion of the corn plant is eaten than of the sorghum, and this whether fed in the form of silage or shredded fodder. Whether the plan of cutting sorghum while the plants are young and recutting frequently the suckers that are thrown out, is a good one or not remains for future experiments. Trials elsewhere show the practice of pasturing sorghum fields after the first crop is cut to be attended with danger.

Kaffir Corn.—This plant is a sorghum, but one that does not produce a sufficient amount of sugar in its juice to make it valuable as a source of molasses or sugar. It is therefore called a non-saccharine sorghum. While growing in the field it resembles corn. The ears at the side of the stalk are wanting, however, as it bears its seeds at the top.

A half acre of ground adjacent to the half acre plots of sorghum and Salzer's fodder corn was planted to Kaffir corn May 5th, 1896. The rows were three feet apart and the hills 18 inches apart in the row. It was cultivated first with a Breed's weeder and afterwards with the horse cultivators, at the same time and in the same way as the sorghum. The crop was harvested into the silo early in September, the gross yield per acre being 34,360 lbs.

An analysis of the green fodder was not made; that of the silage is reported as number 33 in the table, page 88.

The cows ate both the silage and the dry fodder of Kaffir corn with considerable relish. The main objection to the plant seems to be its stiff, woody, pole-like stems, which the cows will eat, neither when put in the silo nor when fed as dry fodder. It is slow to start in the spring, makes a tall growth and yields an abundance of green forage to the acre. As the analysis of the silage indicates, this growth is watery and much less valuable, pound for pound, than the same weight of corn. While the feeding tests made at this station have led to no positive results, they show negatively that Kaffir corn has so far shown no right to be reckoned as of equal value with corn as a forage crop for Michigan.

Clover Hay.—It has been impossible, in recent years, to obtain on the college farm until the season of 1897 a pure clover hay. Heretofore the nearest approach to it has been a mixture of timothy and clover. The root borer has not been as destructive during the fall of 1896 and the spring of 1897 as for the three years preceding, and full crops of clover hay are again possible.

This forage crop has proven valuable, first, because it is relatively rich in protein and digestible nutrients, and secondly, because it derives a large proportion of the fertilizers necessary to its growth from the air.

It would be out of place in this bulletin to go into a discussion of the utilization of the free nitrogen of the air by leguminous crops in general, and by clover in particular. For the purposes of this discussion it is enough to remember that while a clover crop does exhaust to some extent the mineral constituents of the soil, still as a net result of the production of a crop of clover hay, a field is actually enriched in nitrogen.

This fact was clearly shown by an experiment performed at the station in the summer of 1897. A sandy knoll was bearing a heavy crop of clover. A section of earth four feet long by two feet wide in the clover plot was dug about and left standing, the earth on all four sides being removed to a depth of four feet. By means of iron rods thrust through the mass of earth from a strong board at each end and cross rods extending from side to side, the clover roots were held in place while the sand was washed away. Many of the finer roots were washed away with the sand. After removing the mass of tops and roots from the place in which they grew, it was photographed and separated into two parts by cutting the clover an inch above the crown, thus removing with the tops more than would be removed in the crop of hay. The experiment was performed July 2nd, while the clover was in full bloom.

The green tops weighed 2.44 lbs., and the roots 2.14 lbs. The dry matter in the tops weighed .99 lbs. and in the roots .656 lbs. A chemical analysis of the tops and roots showed the following composition of the dry matter:

Composition of clover forage and roots.

	Tops. Per cent.	Roots. Per cent.
Nitrogen	2.48	2.53
Potash	1.82	1.21
Phosphoric acid	.68	.83

Reducing these figures to the amounts of these fertilizing elements in the tops and roots on an acre, the results can be better appreciated.

Fertilizing constituents in the tops and roots of an acre of clover in full bloom.

	Tops.	Roots.
	lbs.	lbs.
Nitrogen	132.31	62.07
Potash	96.92	46.51
Phosphoric acid	36.26	31.90

In Bulletin 9, of the Mass. (Hatch) Experiment Station, analyses of six samples of barn yard manure are reported. Using the average of these analyses as fairly representing the composition of average barn yard manure, it is possible to estimate how many tons of manure it would take to supply to the soil the amount of nitrogen left in it by the roots of a heavy crop of clover. According to the figures obtained from the bulletin referred to, barn yard manure contains .289 per cent of phosphoric acid, .582 per cent of potash and .441 per cent of nitrogen. To supply the amounts of these elements left in the soil in the roots of the crop of clover it would require 7 tons of manure per acre to furnish the 62.07 pounds of nitrogen, four tons to supply the 46.51 pounds of potash and five and one-half tons to supply the 31.90 pounds of phosphoric acid. A large share of the nitrogen in the roots of the clover is a direct gift of the crop to the soil, since it is taken from the air. The same is not true of the mineral elements, the potash and the phosphoric acid. These materials are derived by the clover roots from the soil; they get them, however, partly, at least, from strata of the soil below the reach of the shallow-rooted cereals and by their decay leave them where the subsequent crops can reach them. By adding to the store of nitrogen, by loosening compact soils by means of their deeply penetrating roots, and by bringing closer to the surface mineral matters which are far toward escaping from the roots of the cereals, the clover crop aids in restoring fertility to the soil.

These facts are true, notwithstanding the fact that the hay carries away with it a hundred and thirty-two pounds of nitrogen, nearly 100 pounds of potash, and over a third of a hundred pounds of phosphoric acid per acre. If the hay is fed on the farm this fact is immaterial, since these manurial elements will be returned with but slight reduction in the resulting manure; but, if it is proposed to sell the clover hay, this richness in the essential elements must be remembered.

The palatability of clover hay is greatly injured by rain at the time of haying. Clover is very succulent and dries slowly. If, when partly cured, it is wet by rain, part of its soluble constituents are removed. To dry it, the hay has to be turned, or, perhaps, shaken up by a tedder. This operation shakes off part of the leaves, and if repeated many times the feeding value of the clover hay is greatly reduced. An attempt has been made to avoid this loss by storing the clover in the silo, as fast as cut by the mower. Early in July, 1897, a small experimental silo, ten feet deep and six feet in diameter, was filled with green clover. It held 2,773 pounds. It was opened in September, when it was found that the silage had kept most excellently and had shrunk in weight to 2,587 pounds. The cows were running at the time on fairly good pasture, but ate the clover silage with avidity.

To determine how much well cured clover hay was represented by the silage, 4,691 pounds of green, freshly cut clover was spread out to dry on the 8th of July. On the 10th it was cured sufficiently to draw to the barn. It then weighed 1,960 pounds. On the 12th of November, when it was taken out for feeding, it weighed 1,740 pounds, or 37 per cent of the original weight. The 2,773 pounds of silage represented, therefore, 1,026 pounds of well cured hay. The chief objection to putting the clover in the silo is that it is slow and expensive work to draw to the barn so much water. The green clover is inconvenient to handle, is raked up with difficulty and makes hard work pitching on and off the wagon. The comparative losses of field curing and siloing have not been determined.

This trial of clover silage was a repetition of a similar test of a previous year. All that is shown by these tests is that it is possible to ensilo clover, that the silage keeps well and that stock will eat it with evident relish. Nothing can be added to the value of the clover by the process, but probably the losses in the silo are no greater than when the crop is field cured. The expenses of harvesting are, however, much greater, when the weather is fine. It is cheaper to allow the sun to dry the hay than it is to draw the green forage to the barn. There is, of course, less risk in bad weather with the silo than by the older method.

VARIETIES OF CLOVER, METHODS OF CULTURE AND YIELDS.

The seed was selected after careful inspection to prevent the introduction of such weeds as buckhorn plantain, and was sown on the growing wheat in the spring of 1896, during the month of April, and, as far as possible, in the first week of that month. Experiments carried on for two sucessive years had demonstrated that in ordinary seasons the earlier the clover seed is sown in the spring the greater the probability of a full crop. The seed was sown in the early morning, while the ground was frozen and while the air was still; a wheelbarrow seeder and various hand devices were used in scattering the seed. On the north half of field 9, pure medium red clover was sown; on the south half of the same field mammoth clover, and on field 12, which contains a great variety of soils, alsike seed, mixed with various grasses. The season of 1896 was favorable on the whole to the growth of the clover plants, which, after the removal of the wheat crop, grew so rapidly as to necessitate running a mower over the field and the removal of nearly a ton to the acre of hay in the fall of 1896.

Neither cattle nor sheep seemed to like this fall crop of clover, although secured without exposure to rain. It was stored in the barn, and the attempt to feed it was made in the cold weather of winter, with but very partial success. The dairy cows rejected it, and the lambs would not eat enough of it to make a respectable growth. It had to be used, therefore, largely for bedding. Its removal was, however, necessary, to prevent smothering the clover plants during the winter.

The winter of 1896-97 was favorable to clover, and the crops made a good growth and were ready for the mower by the last week in June. On the 23d of that month a measured acre on the west end of No. 9 was cut and field cured. The yield was 4,200 pounds of hay in good condition to go into the barn. Field 12 was used as a pasture through the season. The field contains 34 acres. On it 18 head of growing cattle were pastured from the early part of May through the season. Mowers were put in the field June 24th, and the hauling of the hay was completed on the 30th. The yield for the 34 acres was 35 tons, 1,940 pounds of field cured hay. No rain fell while the crop was being gathered, and the hay was of most excellent quality, green in color and free from dust.

The yield from field 9, 23.8 acres, was 53 tons, 1,677 pounds, or two tons, five hundred and twenty-four pounds per acre. No tests have been made of the relative feeding value of the hay from medium, alsike and mammoth clover. The practical identity in composition of red clover and alsike hay is *prima facie* evidence that they are of practically equal value. Mammoth clover hay is not eaten as clean as medium, because of its woody stems.

Crimson Clover.—The attempt has several times been made on the Station grounds to grow crimson clover as a forage plant. It has been sown usually in the fall or late summer. It has been usually either entirely killed by the winter, or so far injured as to make it impracticable to leave the remnants for harvest. On April 26th, 1896, ten pounds of crimson clover seed was sown on the north east half acre of field 8. The seed was sown with a grass seeder and harrowed in with a light slanting tooth harrow. The plants were slow in making their appearance, but by the 13th of May the ground was well covered. The early part of June was warm and wet, facilitating its growth. The crop was cut with a mower on the 24th of June and weighed, a sample being taken for the determination of moisture. The yield of the half acre was 1,870 pounds, containing 77.41 per cent of moisture. The yield of dry matter per acre was, therefore, 844.87 pounds. The weather continuing moist and warm, the crimson clover made a very rapid second growth. When pastured by sheep along with an adjacent field of rape, the latter was much preferred to the crimson clover, which, however, was pastured close after the rape was exhausted. Notwithstanding this ill treatment, the crimson clover withstood the winter well, and covered the ground with a green coat in the spring of 1897. No feeding experiments were tried with crimson clover hay.

Vetches.—April 27, 1896, one-half acre was sown with a grain drill to vetches and oats, 25 lbs. of vetches and 32 of oats being used. The oats germinated much the more rapidly and hardly a plant of the vetch was seen until the oats were harvested. The field notes record, under date of June 9th, that the vetches were making but a poor growth as the oats were far above them. On July 6th the oats and vetches were ready to cut, the oats being fully headed and ready to turn. Because the vetches had made such meager growth, however, the harvesting of the plot was delayed to July 29th, when the oats were fully ripe. The crop was drawn to the barn August 1st, when it weighed, in rather damp condition for storing, 2,132 pounds. As soon as the oats were removed the vetches began to show themselves. The field notes through August show that they grew rapidly and completely covered the ground before the close of that month. There was a severe frost on September 19th, which did not injure the vetches, though it stopped the growth of the second crop of sorghum on adjacent plots. The vetches were cut and fed to sheep, which did not seem to like them and would not eat them until practically forced to do so. The continuous rains made it impracticable to harvest the vetches for hay, and no feeding experiments could therefore be conducted during the winter with this crop. Where the heavy fall growth was mown and removed the vetches withstood the winter and were green in the spring of 1897, but where it was left on the ground the plants were entirely smothered. The crop is worthy of further trial because, among other reasons, it belongs to the great family of plants that have the ability to utilize the nitrogen of the air. By the decay of its roots it leaves in the soil available for other plants, a large amount of this most costly manurial element which it has gathered during the period of its growth.

Peas.—To supplement the pasture in case of drouth and to afford a most excellent hay if not needed for summer feeding, it is the custom on the college farm to sow some considerable area to peas, usually with oats. The ground is prepared in the fall and the seed put in the ground at the earliest possible moment in the spring. Two bushels of peas are used per acre. If in the latter part of March the surface of the ground is sufficiently dry the peas are either sown broadcast on the surface and plowed under three to four inches deep or put in with a grain drill as deep as possible. The oats are sown shallow later at the rate of one bushel of oats to the acre. Careful records are not at hand to show the yield per acre of this crop, nor have comparative feeding trials been instituted to determine its relative value compared with clover hay or other forage crops. Experience has demonstrated that cattle like the hay and that they eat it in sufficient quantities to produce a full yield of milk and butter. On several occasions the crop has been harvested into a silo, making a silage richer in protein than any other silage fed at the station. Its per cent of dry matter when fed was 49.92 and its per cent of protein fully 4.5 per cent. When first put in the silo, owing to unusual succulence, the peas and oats make a very wet silage. If the silo is not absolutely tight much of this juice escapes, and the silage when fed is correspondingly dry.

Alfalfa.—The plot of alfalfa, the behavior and yield of which has been reported in previous bulletins of the Station, was completely destroyed by the severe weather in the early months of 1897. In May hardly a root was left alive, and scarcely a green stem showed above the ground.

Rape.—A half acre of rape was sown in the spring of 1896 in the east end of No. 8, by the side of a similar area of vetches and oats, and near the half acre plots of sorghum and fodder corn, the yields of which are reported on page 98. Three pounds of rape seed were sown April 23d, with a wheelbarrow seeder and the ground was gone over with a light harrow the next day. No further cultivation was given the crop, which was cut and put in the silo June 24th. The total weight of green rape was 6,955 pounds, containing 80.75 per cent of moisture. The yield of dry matter per acre was therefore 2,677.67 pounds. The cows ate the rape silage with evident relish, and no taint was imparted to the milk by it. Further experiment will be necessary to establish the practicability of rape either as green fodder or as silage, for a cow feed. After the removal of the first crop of rape it sprang up again quickly, and was pastured with the half acre of crimson clover adjoining, through the fall. On August 10th it was noted that the sheep much preferred the rape to the crimson clover, and that they had eaten the former well into the ground before attacking the latter, the flock having been put on the field July 27th.

Millet and Hungarian Grass.—In former bulletins of this Station the investigations in regard to the methods of growing these grasses and the adaptability of the many varieties have been fully discussed. The millet grown on the farm has been fed for the most part as hay. On one or two occasions the green fodder has been put in the silo. The silage is liked by the cows, and when fed keeps up the flow of milk and butter. It is unusually dry for silage, containing, as it did in 1896, but 57.10 per cent of water. When pitched out of the silo it was light and fluffy, resembling hay rather than silage. It had a pleasant odor and kept with very little spoiling. Millet is to be recommended to every dairyman because it can be sown late in the season after a crop of peas and oats has been removed, or can be substituted for corn when the spring work has been so delayed as to make the planting of the latter impracticable.

Mangolds, Carrots, Sugar Beets and Rutabagas.—Where silage is not used it is wise for the dairyman to provide succulence for the winter ration in the shape of some kind of roots. The three which suggest themselves as probably yielding the most food products for the labor and money expended in growing them are mangolds, sugar beets and carrots. Turnips and rutabagas need be used in the dairy with extreme caution, because of their liability to impart an unpleasant taint both to the milk and to the products made from it. It is true undoubtedly that rutabagas can be fed to dairy cows in such a way as to avoid this taint in the milk. But precautions as to the manner or amount have to be taken, and sometimes this precaution is apt to be neglected, with the result that the sample of butter is injured and perhaps a customer permanently offended. The reasonable use of the other roots is attended with no such danger, and for this reason they are recommended to be grown by all dairymen, whether possessed of a silo or not. The area devoted to them need not be large, but roots add a needed variety to a winter ration and repay their cost in the increased healthfulness of the cow as well as in the butter produced.

An experiment was tried during the summer of 1897 to compare the cost of growing and yields per acre of ox heart carrots, yellow tankard mangolds, long red mangolds and rutabagas. The plot devoted to the experiment contained three quarters of an acre. The rows were 22 inches apart and 30 rods long. One quarter acre was planted to ox heart carrots, the adjoining quarter to the mangolds, one eighth to the tankards and one eighth to the long reds, and the remaining quarter to rutabagas. The yields per acre were as follows:

Yields of roots per acre.

	Yield per plot.	Yield per acre.	Dry matter.	Dry matter per acre.
	lbs.	lbs.	%	lbs.
Carrots	7,209	28,836	11.52	3,321.90
Long red mangolds	3,208	25,616	13.20	3,381.30
Tankard mangolds	2,718	21,744	9.71	2,111.30
Ruta bagas	7,757	31,028	12.06	3,741.98
Sugar beets	----------	28,320	18.88	5,346.80

The largest yields, both of gross weight and dry matter, is given by the rutabagas, the long red mangolds following next. The average yield per acre of four acres of sugar beets adjoining was 28,320 pounds.

The mangolds were sown May 10th, using 9.6 pounds of seed per acre. The carrots were sown the same day, applying two pounds of seed to the acre. The rutabagas were sown May 17th, 2.8 pounds of seed per acre. The ground had been in corn the year before, and was thoroughly subsoiled in April. The cost of preparing the ground, marking, planting, cultivating, thinning and hoeing, was practically the same per acre for all the roots. The work per acre may be tabulated as follows:

Labor per acre in growing roots.

	Man and team. Hours.	Man. Hours.
Plowing and subsoiling	12	
Harrowing	3.75	
Marking	.8	
Planting	---------	3.25
Cultivating	15	
Thinning and hoeing	---------	75.90
Harvesting	1.25	130.75
	32.80	209.90

The hand labor in harvesting was performed by boys at eight cents an hour. The 79.15 hours spent in hoeing and thinning was done by men at twelve and a half cents an hour. The team work is reckoned at twenty-five cents an hour for man and team. At these prices the cost of labor for growing and harvesting an acre of roots was $28.55. The labor of harvesting an acre of mangolds was appreciably less than for an acre of sugar beets or carrots. The cost of labor per ton of carrots was slightly less than $2.00 per ton, of rutabagas $1.84 and of mangolds $2.51. The season was unfavorable to the growth of mangolds, on account of the long and severe drouth, but the other root crops were subjected to exactly the same conditions.

On page 98 the yields per acre of dry matter by sorghum and silage corn on the same field the previous season were 7,700.39 for the sorghum and 8,655.85 for the silage corn.

It has been demonstrated by many experiments in several experiment stations, that sugar beets are one of the best of root crops to feed to live stock, either dairy cows or fattening animals. Cows are very fond of them, and their great richness in sugar and other completely digestible carbohydrates make them a very valuable stock food. Owing to the fact that they grow deep in the earth it is more costly to harvest them than other roots, but this is compensated by their greater richness in sugar.

Effect of Roots and Potatoes on the Digestibility of Rations.—As shown by the rations reported on page 90, roots have formed no inconspicuous part of the ration, even when ensilage is fed. It is interesting to note whether the addition of roots to a ration affects the digestibility of the ration, and in the second place, what effect such addition has upon the quality of the butter. Upon the first point a digestion experiment was conducted at the station by Prof. C. D. Thompson of the Oregon Agricultural College, in the spring of 1896, while he was doing post graduate work. The essential facts of this experiment carried out by Mr. Thompson, under the supervision of the director and chemical department of the station, are reported below.

Two cows were used, Halo, a grade Jersey, six months in the period of lactation, and weighing 750 pounds at the beginning of the experiment, and Milla, a grade Shorthorn, three months in milk, and weighing 950 pounds. The basic ration was made up of 14.5 pounds of clover hay, 6.5 pounds of corn meal and 6.5 pounds of wheat bran per thousand pounds live weight per day. The usual precautions were taken to secure representative samples, and analyses were made of the feeding stuffs used, with the following results, the figures under ash, protein, crude fiber, N. free extract and fat referring to the proportion of these constituents in the dry matter and not in the original substance.

Composition of feeding stuffs.

	Dry matter. Per cent.	Ash. Per cent.	Protein. Per cent.	Crude fiber. Per cent.	Fat. Per cent.	N. free extract. Per cent.
Bran	87.2	4.3	15.69	4.84	4.0	71.17
Corn	87.8	1.6	13.18	2.30	5.2	77.71
Mangolds	9.5	10.3	15.31	7.00	2.00	65.39
Potatoes	21.00	6.7	12.87	2.31	.70	77.42
Hay	88.00	7.2	12.75	36.00	4.20	39.85

After a preliminary period of 11 days, in which the cows were fed upon the rations to be used in the first period of the actual experiment, the first feeding period began. During its continuance the cows were fed mangolds, with the ration of hay, cornmeal and bran. An intermediate period followed, in which the mangolds were gradually removed and the cows prepared for Period II, in which no roots were given. At the close of this period the ration was again gradually changed by the addition of potatoes. It required ten days to accustom the cows to the new ration, after which the third period of the test began. In Period I the daily ration was composed of 14 pounds of clover hay, 6 pounds bran, 6 pounds of corn meal and 20 pounds of mangolds. In Period II the ration was 14.5 pounds of clover hay, fed with six and one half pounds each of bran and corn meal. In Period III the ration was 12.5 pounds of clover hay, 6 pounds of bran, the same of corn meal and 15 pounds of potatoes. The cows were fed their weighed rations at seven a. m., and 5 p. m., in tight boxes on an elevated platform. The stalls were thoroughly cleaned at the beginning of each period, and the cows were placed in charge of attendants both day and night, whose duty it was to collect separately the solid and liquid excrements. Records were kept of the weights of each excreted and also of the weight of milk yielded at each mess. A sample of the milk was put in a glass can and the composite sample analyzed at the end of each three days.

The duration of Period I was six days, of Period II six days and of Period III four days. The following tables show the amount of hay, grain and roots consumed by Halo and Milla in the three periods, and the amounts of dry matter, ash and nutrients which they contained:

Name.	Period.	Hay.	Corn.	Bran.	Roots.	Dry matter.	Ash.	Fat.	Crude protein.	Crude fiber.	N. free extract.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Halo	I	63	27	27	90	111.24	6.27	4.67	15.18	22.25	62.87
Milla	I	84	36	36	120	148.30	8.35	6.22	20.26	29.66	83.81
Halo	II	66	30	30	------	110.58	5.73	4.86	14.97	22.78	62.24
Milla	II	87	39	39	------	144.80	7.51	6.36	19.60	29.99	81.34
Halo	III	38	18	18	45	74.39	3.97	2.91	10.01	13.38	44.12
Milla	III	50	24	24	60	98.60	5.25	3.88	13.29	17.62	58.56

These tables show a remarkable uniformity in the consumption of dry matter. In Period I it was on the average 24.71, in Period II 24.13 and in Period III 24.65 pounds per day per thousand pounds live weight, a variation of only .58 of a pound.

The weight of Halo remained constant at 741.6 pounds during the first period, dropped to 733.6 during the second and to 722 during the third. That of Milla shrank from 939.6 to 913.3 during the first period, increased in the intermediate period to 952.3, dropped again to 922.3 during the second period, and gained from 932 to 937 during the third period. A record was made of the amount of water drunk each day, and these fluctuations in weight were due in the most part to the variations in the amount of water drunk. In only one instance was there a striking variation in weight which could not be accounted for. and that was the loss of 30 pounds on the part of Milla in Period III, and even in this case it was noted that the cow drank more than 30 pounds more water on the day of the beginning of that period than on the day of its close.

It is evident that the parts of the food which passed through the system undigested and appearing in the dung should be subtracted from the whole amount of that constituent fed in order to determine the amount of it absorbed into the system and utilized by the animal. Hence in the following table there is contrasted the amounts of dry matter, of ash and of each of the nutrients consumed by each cow in each period, and the amounts of each that appear in the dung of each cow for each period. The differences will give the pounds digested. This is done in the following table; in which, since Period III lasted but four days, the figures for that period are multiplied by one and a half, the more readily to compare with the figures for the other periods, which were one and one half times as long.

Derivation of coefficients of digestibility.

	Dry matter.	Ash.	Fat.	Crude fiber.	Crude protein.	N. free extract.
Halo—Period I:	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Consumed	111.24	6.27	4.67	22.25	15.18	62.87
Returned in dung	37.13	3.21	1.19	11.36	5.94	15.43
Pounds digested	74.11	3.06	3.48	10 89	9.24	47.44
Per cents digested	66.62	48.80	74.52	48.94	60.87	75.45
Milla—Period I:						
Consumed	148.30	8.35	6.22	29.66	20.26	83.81
Returned in dung	50.78	4.38	1.93	13.71	8.06	22.70
Pounds digested	97.52	3.97	4.29	15.95	12.20	61.11
Per cents digested	65.76	47.54	68.97	53.78	60.22	72.91
Halo—Period II:						
Consumed	110.58	5.73	4.86	22.78	14.97	62.24
Returned in dung	40.11	3.25	1.02	11.91	5.89	18.04
Pounds digested	70.47	2.48	3 84	10.87	9.08	44.20
Per cents digested	63.73	43.28	79.01	47.71	60.65	71.01
Milla—Period II:						
Consumed	144.80	7.51	6.36	29.99	19.60	81.34
Returned in dung	51.32	4.16	1.32	15.07	7.86	22.91
Pounds digested	93.48	3.35	5.04	14.92	11.74	58.43
Per cents digested	64.55	44.60	79.23	49.75	59.90	71.83
Halo—Period III:						
Consumed	111.59	5.95	4.37	20.08	15.02	66.17
Returned in dung	44.79	3.25	1.66	13.01	6.63	20.24
Pounds digested	66.80	2.70	2.71	7.07	8 39	45.93
Per cents digested	59.86	45.37	62.01	35.20	55.85	69.41
Milla—Period III:						
Consumed	147.90	7.87	5.80	26.45	19.94	87.84
Returned in dung	49.36	3.98	1.82	15.17	8.40	19.99
Pounds digested	98.54	3.89	3.98	11.28	11.54	66.85
Per cents digested	66.62	49.23	68.62	42.64	57.87	77.24

The digestive work of the two cows was wonderfully uniform, not differing essentially in the digestibility of any constituent of the ration in either period. We are safe, therefore, in taking the average per cent of digestibility in each case. The following table gives the average per cents of digestibility for the various factors in each period:

Coefficients of Digestibility.

	Dry matter.	Ash.	Fat.	Crude fiber.	Protein	Nitrogen free extract.
Period I	66.19	48.17	71.74	51.36	60.54	74.18
Period II	64.14	43.97	79.12	48.73	60.27	71.42
Period III	63.24	47.40	65.32	38.92	56.71	73.33

In passing from Period I to Period II it is evident that the removal of the beets from the ration decreased the digestibility of the dry matter, ash, crude fiber and N. free extract, while the digestibility of the protein remained constant. The addition of potatoes to the ration still farther decreased the digestibility of the dry matter of the crude fiber, and markedly lowered the digestibility of the protein. This result is undoubtedly due to the fact that potatoes are nearly clear starch, and the addition of so much starch to a normal ration lowers the digestibility of the protein, the fat and the crude fiber. There is a real and apparent discrepancy in the work of the two cows and the results they show in the coefficients of digestibility in Periods II and III. Whereas Halo digested a greater per cent of every constituent of the ration except the ash in Period II than in Period III, Milla, while agreeing with Halo as to the ash, fat, crude fiber and protein, digested, on the other hand, more of the dry matter and nitrogen free extract in Period III than in Period II.

Effect of Potatoes and Roots on the Quality of the Butter.—In the winter of 1896, in the months of November, December and January, an experiment was performed to test the effect of feeding beets or potatoes with a ration consisting otherwise of clover hay, corn stalks and a grain mixture of one part oil meal, two parts oats, three parts bran and four parts corn, or one part oil meal, two parts corn, three parts bran and four parts oats, since both combinations were used during the progress of the experiment. The five cows, College Pauline America, College Houwtje, Cara, Milla and Halo, were used for the experiment. For the period beginning November 13th and ending December 1st no roots of any kind were fed. The milk of these cows from November 29th to December 2nd, was saved separate from the rest of the herd, churned separately and the butter analyzed and tested for hardness. From December 2nd to December 22nd, mangolds were fed, in addition to the ration of hay, cornstalks and grain.

The periods were too short to note any material changes in the quantity of butter fat yielded or to establish any relation between feeding roots and potatoes and variations in the yield of butter fat. The analyses of the butter and the records of the churnings do show, however, variations due to the influence of the potatoes or mangolds. The average per cent of fat lost in the buttermilk when the cows were fed nothing but dry food was .022, when mangolds were added it was .027, when potatoes were fed it was .025. Here the variation was immaterial. The average acidity of the cream was from 40 to 42.2 c. c. of decinormal to the 50 c. c. of cream and was not different in the three periods. The average temperature of the cream when the churning was complete was on dry feed 58.8, on mangolds 59.6 and on potatoes 59.3. The average time required for churning was on dry feed 34 minutes, on mangolds 36 minutes and on potatoes 86 minutes. On this point there was a very marked difference due to the feeding of potatoes. The cream frothed badly in the churn and it took more than twice as long to bring the butter. The chemical analyses of the butter in the different periods is reported in the table below, in which the hardness is determined by dropping a steel rod weighing 50 grams, 7 millimeters in diameter and 203 millimeters long dropped two meters. The distance the end of this rod penetrates the butter measures its softness. The farther the rod penetrates the softer the butter.

Composition of Butter from Dry Feed and from Potatoes.

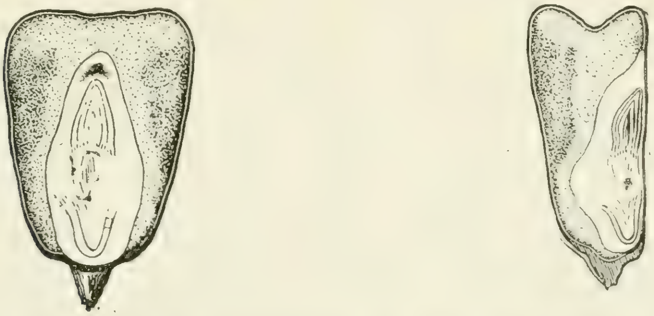
	Water per cent	Ash and casein per cent.	Fat per cent.	Volatile fatty acids, c. c.	Melting point centigrade.	Hardness, m. m.
I Dry food	8.28	2.85	88.86	26.5	32.6	18.7
IV Dry food	6.93	3.36	89.01	30.4	----	15.3
Mangolds	8.24	2.63	89.13	27.6	32.23	16.7
III Potatoes	6.37	3.50	90.13	28.0	----	18.7
V Potatoes	5.42	3.03	91.55	33.4	32.4	12.3
Average potatoes	5.89	3.26	90.84	30.7	32.4	15.5
Average dry food	7.60	3.07	88.93	28.45	32.6	17.00

Potatoes did not constitute an abnormal proportion of the ration and no important difference is noted in the composition of the butter that could be ascribed to the potatoes. In one case the butter was much harder where the cows had the potatoes, in another it was as soft as when the cows were on dry feed. The per cent of volatile fatty acids, the ingredients that give butter its characteristic flavor, was slightly higher on the average in the potato butter than in the butter from dry feed.

Corn Meal.—Corn meal has been an ingredient of nearly every grain mixture fed the college dairy cows for the past three winters, and this notwithstanding the fact that silage has formed the bulk of the ration. At the ordinary market prices it furnishes digestible nutrients cheaper than any other grain or by-product. While relatively low in protein, it can be used to good advantage with clover hay and wheat bran or oats, the oats or bran supplying the protein necessary to balance the ration. When the corn has not been mixed with oats or bran the cob has sometimes been ground with the kernel to make a meal less compact and of less specific gravity. Corn cobs have little feeding value, and it would rarely pay the farmer to cart them to mill and pay for grinding them, where he pays for the grinding by the hundred, but where the grinding is done by windmill or other cheap power on the farm itself, it will pay to grind the cob with the corn to act as a diluent. In such cases the cob must be ground very fine.

With silage, corn has usually been mixed with linseed or cotton seed meal, bran and oats, in the proportion of two parts of corn meal to eight of the other grains or by-products. Not infrequently the corn has been fed the cows unhusked and with the stalks. In that case the shocks have been drawn directly from the field, run through a cutting box and fed with wheat bran and clover hay. A good proportion of kernels escape digestion, and for the sake of economy it has been found necessary to follow the cows with pigs to consume the corn in the droppings. Where human labor is high in price and corn relatively cheap this method recommends itself.

Gluten Meal and Gluten Feed.—Several tons of gluten meal have been feed at the station, and since the feeding stuff is comparatively new to the state, a reference to its value and place in the ration is here made. These gluten feeds are the residue from the manufacture of either glucose or starch, and differ in composition, according to the method of manufacture and to the thoroughness with which the starch is extracted in the process. These methods of manufacture differ very materially in their results but they consist essentially in the separation of the outer coating of the kernel and the germ from the interior starchy portion. This is done by machinery and by soaking the crushed kernels in water. In the process the germ may or may not be separated from the gluten and the skin. The gluten in the kernel resides in the layer of cells immediately beneath the skin. If the corn is yellow these gluten cells are yellow. They are characterized by a high content of both protein and fat. The germ occupies the point of the kernel, from which the sprout comes as the kernel germinates. It is rich in oil and gluten.



Cross sections of a kernel of corn showing the skin, immediately below the skin a layer of gluten cells, next the mass of starch in the interior, hardened at the sides and finally the germ near the point but not projecting from it.

Prof. E. B. Vorhees, of the New Jersey Experiment Station, reports in Bulletin 105, of that station, page 7, the analyses of the kernel of corn, of the skin, of the germ and of the starchy and hard parts, in the following table:

Station number.		Amounts secured from 100 parts of original corn.	Per cent of water.	Fat.	Crude fiber.	Protein.	Ash.	Carbohydrates.	Nitrogen.	Phosphoric acid.	Potash.
905	Original corn	100.00	24.74	4.34	2.02	12.65	1.73	79.26	2.02	.83	0.47
906	Skin	5.56	15.29	1.59	16.45	6.60	1.27	75.36	1.06	.23	0.38
907	Germ	10.17	29.62	29.62	2.88	21.71	11.13	45.79	3.48	6.16	2.91
909	Starchy and hard parts	84.27	24.66	1.54	.65	12.23	.68	85.58	1.96	.35	0.17

"The germ, although only about 10 per cent of the whole kernel, contains 65 per cent of the fat, 61.5 per cent of the mineral matter, 71 per cent of the phosphoric acid, 60 per cent of the potash and 16.33 per cent of the nitrogen or protein. The remaining portions are characterized, the skin by the content of fiber, 51 per cent of the whole, and the starchy parts by the carbohydrates, of which it contains nearly 90 per cent of that in the whole grain."

It is evident from these analyses that the composition of the by-products made from corn depends on whether more or less of either the germ, the skin or the starch is left in them. If the starch alone is removed the trade name of the product is gluten feed. The germ ground alone is called germ meal. The gluten cells alone or with the germ is called gluten meal. These names are used, however, indiscriminately, and it is quite impossible to gather any correct idea of the composition of these by-products from the names alone. The gluten meal should be richer in protein than the gluten feeds. Below are given the analyses of gluten feeds and gluten meals, taken from the Bulletin 105 of the New Jersey Station, to which reference has been made:

Name.	Pounds per hundred of—					
	Water.	Crude fat.	Crude fiber.	Crude protein.	Crude ash.	Carbohydrates.
Chicago gluten feed	7.61	14.18	6.31	24.03	0.87	47.00
Peoria gluten feed	6.94	14.81	7.11	22.64	.97	47.50
Buffalo gluten feed	10.20	13.67	7.17	22.65	.84	45.47
Average of seven samples	8.32	12.74	6.84	21.61	.86	49.63
Cream gluten meal	7.37	15.64	1.45	41.76	1.58	32.20
King gluten meal	9.36	19.77	1.47	35.09	1.90	32.41
Iowa golden gluten meal	7.61	12.65	3.60	30.47	1.00	44.67
Av. of five samples	8.15	14.06	1.66	32.83	1.31	41.99
Av. of three samples Chicago gluten meal	9.49	5.56	1.50	35.79	.86	46.80

These analyses show how variable in composition these by-products are, and dairymen should exercise due caution in their purchase for that reason. At the prices at which they are usually sold the gluten meals furnish protein fully as cheaply as does any other by-product. Cows, while not exhibiting an especial fondness for gluten meal, have seldom refused it when mixed with other feeds. At the college dairy barn it has been fed in amounts as high as four pounds per day, with good results.

For two successive winters experiments were conducted to test the influence of gluten meal on the quality of the butter. It was found as an invariable result that the gluten meal made the butter softer and made it difficult to so churn the cream as to extract all of the butter from the buttermilk. The per cent of fat in the buttermilk invariably increased from .1 per cent to .25 per cent, or even .5 per cent when gluten meal was fed.

Linseed Meal.—There are offered in the markets two classes of linseed meal, old process and new process. Both have been fed at this station with good results. They have been used as a source of protein and to give variety to the ration. Ordinarily the amounts fed per day have been less than two pounds and seldom more than one. In exceptional cases, as in that of Rosa Bonheur, as high as six or more pounds per thousand pounds live weight per day have been fed without injury. The high price of the product prevents its more extended use. The cows prefer the coarsely ground oil cake, the so-called pea size old process linseed meal to the finely ground.

No effect of the introduction of linseed meal on the quality of the butter appears in the records of the dairy work at the station. Fed as it is in connection with a variety of grains, no such effect could be expected.

Cotton Seed Meal.—This by-product heads the list as far as richness in protein is concerned. Its price is usually somewhat higher than that of linseed meal, but ordinarily it will furnish protein fully as cheaply, if not more so, than the by-products of the linseed oil mills. Experience in its use at this station will warrant its recommendation to dairymen to be fed in amounts not larger than two pounds per cow per day. Fed in this way, it supplies a large amount of digestible protein and gives the cow an appetite for the coarser forage plants, like cornstalks or even straw. In purchasing cotton seed meal care should be exercised to see that the indigestible hulls of the seed have been removed.

The feeding of cotton seed meal is usually accompanied by an increased hardness of the butter. If fed in excess, the quality of the butter suffers, as does also the health of the cow. Common-sense, however, will prevent the misuse of a food so inordinately rich in protein.

Wheat Bran—Letters received at the station indicate that in some parts of Michigan a prejudice exists against roller process wheat bran, while elsewhere an equal prejudice is found in its favor. Some farmers prefer finely ground bran, others like better the coarser samples. The product of roller mills is not uniform as to fineness of flakes, some turning out at times a very light and flaky product and at other times bran more finely ground. In some samples of roller process bran the germ is ground with it. In the burr stone process the germ is ground with the flour. In the roller process the wheat is not infrequently dampened before grinding to toughen the outer coats of the kernel and to bring away the bran in as large particles as possible.

In the spring of 1897 the analyses of 14 samples of bran were made by Mr. Lewis S. Munson, and the results presented as his graduating thesis. The work was done under the close supervision of the chemical department of the station, with all the usual safeguards against error. Later three samples of bran were sent to the station from Minneapolis as typical specimens of the first, second and third grades of bran which the large mills turn out. These samples were also analyzed by the chemical department of this station, and the results are given in the tables below, following the analyses reported by Mr. Munson.

Analyses of wheat bran.

Number.	Process.	Annual output.	Protein.	Ash.	Water.	Fat.	Crude fiber.	Starch.	N-free extract.
			per ct.	per ct.	per ct.	per ct.	per ct.	per ct.	per ct.
1	Burr	100 bbls. daily	16	5.36	9.82	1.18	10.03	45.96	57.51
2	Roller	100 bbls. daily	15.38	5.97	10.92	1.89	11.76	40.05	54.06
3	Roller	1,000 tons	15.00	7.01	11.39	1.79	10.72	42.33	54.09
4	Roller	2,000 tons	17.56	5.90	8.01	3.84	9.70	38.61	54.99
5	Roller	2,500 tons	17.56	5.58	8.17	2.96	9.69	42.21	56.04
6	Roller	1,600 tons	14.32	5.59	10.24	3.31	11.23	39.57	55.32
7	Roller	1,200 tons	17.63	5.56	9.14	2.85	10.40	41.49	54.42
8	Roller		16.25	5.83	8.04	3.31	10.19	44 28	56.38
9	Roller	2,000 tons	15.63	6.83	8.65	2.81	12.28	39.06	53.80
10	Burr		16.13	6.17	8.65	2.15	10.90	42.66	56.00
11	Roller	90,000 bbls.	14.75	6.36	8.70	2.54	11.93	40.23	55.64
12	Roller	66,000 bbls.	16.38	6.38	9.72	3.09	10.40	38.43	54.03
13	Roller	2,500 tons	16.94	5.78	8.02	3.20	11.36	43.47	54.70
14	Roller	5,000 tons	17.13	6.33	8.01	2.96	10.81	44.64	54.76
15	Roller, first grade		19.00	5.48	12.38	3.88	9.31		62.33
16	Roller, second grade		16.81	7.67	13.06	3.99	13.90		57.63
18	Roller, third grade		17.13	7.67	13.56	4.57	14.36		56.27

These analyses show us in the first place that over half of the total weight of bran consists of carbohydrates, very largely starch. Second, the richer the bran is in protein the poorer in crude fiber. Third, burr stone bran differs from roller process in containing less fat, due undoubtedly to the fact that it does not contain the germ. Fourth, little variation in its composition is discernable between the samples of extremely coarse bran, like samples 1 and 3 on the one hand, and the fine brans like sample 2, on the other. Mr. Munson says on this topic: "The two extremes, the very coarse and the very fine, are of much the same composition, while neither shows by any means the best sample of bran so far as feeding properties are concerned. The medium grade brans generally show a far better analysis than either of the former." "Theoretically the bran produced by the roller process should be a more valuable food than that produced by the burr stone process, as in the one the germ, which is rich in fat, is separated out with the flour, and in the other this part goes into the bran. This the investigation emphatically bears out. The roller process brans are all perceptibly higher in protein than are those of the burr stone process, and as bran is given as a proteid food, this fact is worthy of consideration. It is not so much the amount of starch present in the bran, as the amount of protein and fat, that is of consideration to the feeder. The end, therefore, for which the millers are constantly working in the milling process, the most complete separation of the starch possible and the needs of the consumer of the bran, namely, a food rich in protein and fat but not necessarily containing much starch, are identical. The new milling process, instead of supplying the feeder with an inferior grade of feeding stuffs, furnishes him with one much superior to that furnished by the old process. The investigation thus credits the production of the better bran to the new or roller process. It shows that the brans rich in starch will be relatively low in fat; that there is also an inverse variation between the protein and the crude fiber; that no marked variation is to be found in the amount of ash; that there is a considerable variation in the composition of the bran produced by the roller process,but that the relative feeding values of these brans are not widely divergent."

The first grade bran from Minneapolis was much the coarsest of the three samples and had a distinctly harsher feeling. It was nearly two per cent richer in protein than either of the others, had a smaller content of fat and of crude fiber and a much larger content of starch. These differences in chemical composition would warrant a slight difference in price in favor of the first grade.

DAIRY BARN.

During the summer of 1897, a new dairy barn was built to hold a grade herd of thirty cows. The plan outlined by the Board involved the erection of the building at the smallest possible cost consistent with efficiency.

The barn is rectangular in form, seventy feet long, north and south, and forty-five feet wide east and west. A driving floor ten feet wide runs lengthwise through the center of the barn, connecting doorways at the middle of the north and south ends. Over this driveway a wagon is driven to haul out the manure. On each side of this center driveway is a gutter sixteen inches wide, four inches deep at the north end of the barn and six inches deep at the south end. The floors on each side of the gutter lap over it, so that liquids falling on them are compelled to escape into the gutter. The bottom and sides of the gutters are two-inch plank, jointed and fitted together water tight.

Running along the edge of each gutter farthest from the center of the driveway is a stone wall upon which stands a row of posts which serve a twofold purpose. They sustain the weight of the hay mow and at the same time serve as the rearmost post of the partitions between the cows. These posts stand upon a two by six hemlock plank which rests upon the wall. The gutter side is spiked to this plank so that the post is two inches in from the edge of the gutter. The spaces between the foundation walls were filled with sand and the floors placed directly upon this sand with no joists except two by four or two by six strips to which the floor plank could be nailed to hold them in place. The floors are level except that of the center driveway which is arched one inch in the middle to compel any water that falls upon it to run quickly into the gutters. The floors are of first class hemlock plank, jointed and dressed on one side.

From the edge of the gutter to the side of the barn is 16 feet making feeding alleys in front of the cows eight feet wide, allowing for an abundant circulation of air and giving plenty of room for convenience in feeding.

The milk and wash rooms are in the northwest corner of the barn and are, together, 16 feet by 8 feet, running from the gutter to the west side of the barn. A sliding door next the gutter keeps the odors of the barn from the milk room to which access from outside the barn is gained by another sliding door four feet wide on the north end of the barn.

Two box stalls for calves and incoming cows are adjacent to the milk room and extend from gutter to feeding alley. They are each 10 feet by 8 feet.

Across the central driving floor from the milk room, in the northeast corner of the barn is a granary, 8x16 feet, extending from the gutter to the east wall of the barn and therefore occupying that entire corner.

In the middle of the barn north and south two stalls on each side are left vacant and the partition removed to make a connecting alleyway between the feeding alley on each side and the central driveway.

The frame of the barn consists of a row of upright two by sixes, sixteen feet long, standing on the 2x8 sills. These upright two sixes stand two feet apart and against them on the outside the matched siding is nailed.

In the west side of the barn there are ten windows, one every seven feet, in the east side but nine, there being no window in the granary. The distance from the main floor to the bottom of the supports to floor of the mow over the cattle is 9 feet. These upper 2x10 floor joists are spiked to the upright two by sixes of the frame at one end and rest upon a beam supported by the row of posts standing between the cows at the edge of the gutter, at the other. This beam is made by spiking together three two by sixes side by side.

The rafters are spliced two by sixes supported by proper purlin plates which in turn rest upon short posts resting on a cross beam on the floor of the mow, which beam is vertically above the beam supported by the row of posts between the cows on the edge of the gutter.

The roof is of steel.

The cost of the barn, exclusive of painting, was as follows:

Foundation, stone and labor	$41.22
Lumber and windows	426.24
Carpenter work	101.00
Roof	122.10
Hardware	20.12
Incidentals	26.32
	$737 00

A row of cows stands on each side of the center drive way and facing away from it. Most of the cows are confined in what are called Bidwell stalls, a style of cow stall patented by Porter Bidwell of McGregor, Iowa. In this stall, as built in this barn, the cow is not tied but is kept in place by a partition on each side high enough to prevent her attempting to jump over it, by a fence in front also high enough to prevent any attempt to escape in that direction, and finally by a chain or rope stretched across behind just above the gambrel joints which prevents the cow from backing out. The width of the stall is so adjusted to the size of the cow that she does not attempt to turn around. Twenty of the stalls in the new barn are three feet and two inches wide. To test the matter eight others are made three feet and four inches wide, but three feet and two inches is wide enough for even large Holstein or Shorthorn cows. The length of the stall is adjusted to the size of the cow by moving forward or back the manger to which is attached the fence across the stall in front of the cow. When the cow is put in the stall this manger is crowded back just far enough to allow her head free movement when her hind feet stand on the very edge of the gutter. To be efficient a stall must keep the cow both comfortable and clean. By allowing free movement of the head and limbs and by permitting the use of sufficient bedding this style of stall allows the maximum of comfort, and since the cow is compelled to stand with her hind feet at the edge of the gutter, cleanliness is assured. The fact that a foul udder is practically never found is sufficient evidence of the efficiency of the stall in this respect.

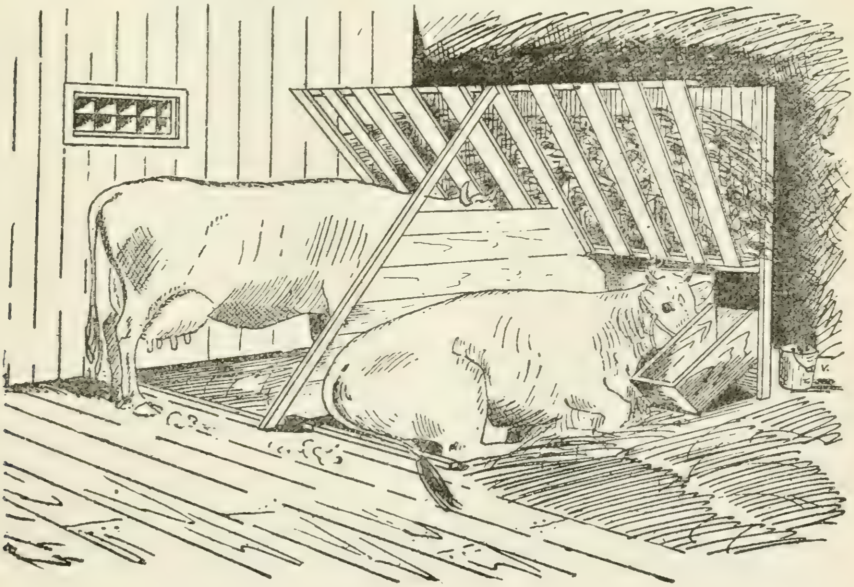
The Hoard Stall.—A second form of stall used in the new barn is called the Hoard stall. It is unpatented and simple in construction. It is described as follows by its inventor, Ex-Governor W. D. Hoard of Wisconsin, in Hoard's Dairyman, of June 23, 1893, page 284:

"The excellence of this plan of tying cows, over the stanchion plan is found as follows:

"(1) The cow has three and one-half feet in width of stall and perfect liberty and comfort of position.

"(2) By virtue of the bar across the stall floor, which will be seen just forward of the hind feet of the standing cow, the animal has always a dry, clean bed to lie in, thus keeping her as clean from manure in winter as though she was in a June pasture.

"(3) By this system each cow is protected when lying down from having her teats and udder stepped on by her standing neighbor. This is one of the most productive sources of injury that is known, and of itself should condemn the rigid stanchion."



"The cut represents one row of cows facing another row. A closely boarded partition about four feet high forms the front of the stall. Each cow has three and one-half feet in width. The floor is made tight and there is no drop in rear of cows, except the thickness of one plank, which is the double floor of the stall. The feeding rack is constructed for two purposes; 1. To contain any hay or roughage that may be fed the cow. The slats are put on wide enough so the cow can easily get her nose between them. 2. To force the cow when standing to stand with her hind feet in rear of the cross bar across the stall floor. In constructing the feeding rack nail a 2x8 piece of scantling edgewise, against the board partition. This constitutes the bottom of the rack and should be placed about 30 inches from the floor. Place the top scantling about two feet from the partition. This makes the feeding rack eight inches wide at the bottom and two feet wide at the top. In the center of the bottom scantling fasten a ring screw to tie the halter to. Fasten the cow with a common web halter, she wearing the head piece all the time; the halter end of the rope has a safety snap to fasten into the ring of the halter under the throat. To prevent the cow from getting loose it is well to divide the end of the rope into two strands each six inches long and put a snap in each, fastening in both, the ring when tying the cow.

"The grain and ensilage box is placed on that side of the stall opposite to the one the cow usually lies on. If she lies on her left side place the grain box on the right side, as seen in the engraving. This box is large enough to contain the ensilage and grain feed, and is reached by an opening in the partition. It is best to have the feed box slant down towards the cow, so that all the feed will easily work down to the end nearest her. This box should be long enough to extend from the partition into the stall as far as the upper part of the feed rack projects and about 18 or 20 inches wide and 16 inches deep. If placed sufficiently slanting, the feed will easily work down to the lower end next the cow, so that she will not need to bring her hind feet in on her bedding, in order to reach the contents of the box.

"In placing the bar across the stall bring the cow's head squarely up against the feeding rack; then just forward of her hind feet nail down a 2x3 scantling. Fill the space forward of the bar with bedding, which being without waste will last till entirely worn out. In this way each cow has her bed in true proportion to her length. It should be made fresh once a week, however, for the sake of health. We commend this stall to all dairymen who are looking for a clean, comfortable method of stabling dairy cows."

SUGAR BEETS IN MICHIGAN IN 1897.

BY C. D. SMITH, DIRECTOR, AND R. C. KEDZIE, CHEMIST.

Bulletin 150.—Farm Department.

INTRODUCTION.

The effort to supply our people from the products of our own soil with so necessary a food material as sugar, now largely imported from other countries, cannot fail to be a matter of deep interest to every person interested in the welfare of the State. Why this country should, year after year, send abroad $100,000,000 in gold to pay for a crop that can be successfully raised on our own soil and manufactured by our own people, has never been satisfactorily answered. The hesitancy to embark in sugar making has hinged upon the question whether our soil and climate are capable of producing sugar beets fit for the factory. It is mainly to settle this question, so far as Michigan is concerned, that the present investigation has been undertaken. The recent legislation in our State offering a bounty on sugar made from beets grown in this State has awakened additional interest among our farmers.

DIVERSIFIED INDUSTRY.

In times of industrial depression, such as the one through which we have lately passed, what the country especially needs is diversified industry, so that the glut of one product shall not cause a stagnation of others. This is especially true in agriculture. In the northern states the three cash crops have been wheat, meat and wool; but wheat has led the industrial race, and the price of wheat has been the business barometer for farmers. The introduction of a new "cash crop" to diversify the old system of rotation, and stop the impoverishing tendency of continuous exportation of grain, is full of promise to the farmer, and gives tokens of prosperity to the business public.

The Honorable Secretary of Agriculture, with an eye that takes in the whole sweep of industrial pursuits, has given a powerful impulse to this industry of national importance. By freely furnishing beet seed of the highest quality to such sections of the country as appear to be adapted to this crop, and by inviting the cooperation of the Experiment Stations in this work, he has done much to bring this new industry into prominence in all the northwestern states.

CLIMATIC CONDITIONS FOR SUGAR BEETS.

For growing most crops, the weather is even more important than the soil. The conditions of climate best suited to growing the sugar beet differ from that of many crops, and the weather that would seriously impair the production in other crops, may be well suited to the crop of beets with a large content of sugar. In Germany, it has been found that a certain average temperature for the several months from May to November, and a certain average rainfall during these several months, are best adapted to the growing of this crop. Such a "sugar beet belt" sweeps through the lower peninsula of Michigan.

Beyond most crops, the sugar beet is less liable to be injured by the variations in weather occurring in our State. It is not a tender plant and will not be injured by spring frosts that would kill Indian corn. It may, therefore, be safely planted in the spring many days before anyone would think of planting corn, and it will grow and ripen in the fall for weeks after the corn is killed by frost. It is practicable to plant the beets early in the spring and get them well established, rooted, and grounded in the soil during our season of abundant moisture, from May to July. When thus established in a well prepared soil, properly thinned from eight to ten inches in the row, kept free from robber weeds, and given proper cultivation to secure the mulch of a thin layer of porous soil, the beets can withstand "the August drought," and thrive and grow when the corn leaves roll for want of rain, and they will continue to grow and sweeten under the Indian summer sun long after potatoes and vines have shriveled under the frosts.

The beet can thrive in the hot and dry weather of mid-summer because of its root distribution in porous soils, the tap root passing down into the subsoil and drawing its supply of water and plant food from these deep recesses. If the plant is nourished by the surface soil till it can tap the subsoil it may thrive in weather that would burn up the surface feeding plants.

Our German consul, Julius Muth, under date of June 3, 1897, writes from the heart of the beet sugar district: "A rich, deep soil, with a porous, well drained subsoil, should be selected. If the climatic conditions are such that the beets are assured of abundant moisture for the first three months, then a limited amount of moisture and dry, sunny weather, for the last thirty days, such lands are well adapted for the cultivation of the sugar beets. It is of great importance that the last thirty days be dry and sunny; wet weather at this period will start a second growth in the beets at the expense of the saccharine contents."—Consular Reports, Aug., 1897.

In a few localities in this State the trial with sugar beets is reported as a failure on account of dry weather, "Not one seed in a thousand grew at all." If the climatic conditions in any locality are too precarious, it would be folly to attempt the cultivation of sugar beets.

THE SOIL.

Certain conditions of soil, both in chemical composition and texture, are best suited to the development of the sugar beet. The plant requires a good supply of potash and phosphates, but its quality is injured by excess of organic matter and nitrates, causing a decrease of sugar and an increase of gum-like or non-saccharine matter, lowering the coefficient of purity. Mucky lands and soils containing an excess of vegetable matter are not suitable for raising sugar beets. In spite of many warnings on this point, many farmers have persisted in planting their sugar beets on muck, with the result of lowering the record for sugar beets in their county and the records for the State at large—in the latter case a reduction of nearly one-half per cent. There can be no objection to farmers planting all the sugar beets on muck they may choose, but they should not offer them as sugar beets for making beet sugar. They are good for fodder and good for nothing else.

The texture of the soil is of great importance. The body of the beet should be entirely covered by the soil, only the crown and leaves appearing above it. No part of the beet that grows above the soil is of value in making sugar. To have the beets thus grow within the soil, the latter must be open and porous, and the subsoil in particular must be penetrable by the tap root as it goes down in search for mineral food and especially for water in the season of surface dryness. This last condition is often not sufficiently considered in preparing a field for sugar beets. The tap root penetrates the soil to a surprising depth if the subsoil is porous, and draws most of the supply of moisture for the plant from the subsoil. If there is enough rain in May, June and July to get the tap root well established on its exploring trip for food and moisture, and the subsoil is open so that the roots freely penetrate the deeper soil, then the "August drought" does not retard the growth of the beet, and the bright sunshine of August, September and October packs the beets full of sugar. But to carry forward this process of saccharine accumulation during such "dry spells," the plant must draw upon the deep vaults of our bank of earth by the tap root reaching the water of the subsoil. Such results can be secured only when the subsoil is penetrable by the beet root. Hence the need of very deep cultivation and of subsoiling by the plow to break up any hard pan. It is also evident that the tap root should not be broken, and this explains why transplanting is often a failure, unless done with care.

An open soil—a loam, sandy loam, clay loam, sandy soil, or gravelly soil—with a penetrable subsoil, is the ideal for growing sugar beets. A stiff clay with a hard pan is the most difficult to manage; and the muck beds are to be rejected entirely.

THE KIND OF BEETS.

The beet now used for making sugar is a highly developed plant, and has been secured as the result of careful cultivation and selection for a long period. When Margraff of Austria announced, one hundred and fifty years ago, the presence of cane sugar in the White Silesian beet in such quantities that sugar could be manufactured from this beet, it only contained from six to seven per cent of sugar. This White Silesian seems to have been the parent of all the sugar beets now in cultivation, and by careful training varieties have been secured containing nearly three times the amount of sugar found in the original beet. Many kinds of beets are in the market that are called sugar beets which are very far from the highly developed and specialized sugar beets required for manufacturing purposes. It should be borne in mind that many so-called "sugar beets" will not profitably make beet sugar.

Some mistakes have been made by Michigan farmers this season by planting seeds that were not true sugar beets. Beets have been sent to the College for analysis that were red, pink or orange in color, whereas the real sugar beet is white, and roots of other colors show either a different variety of beet or a degenerate seed. Mangel wurzels of large size have been sent as specimens of sugar beets.

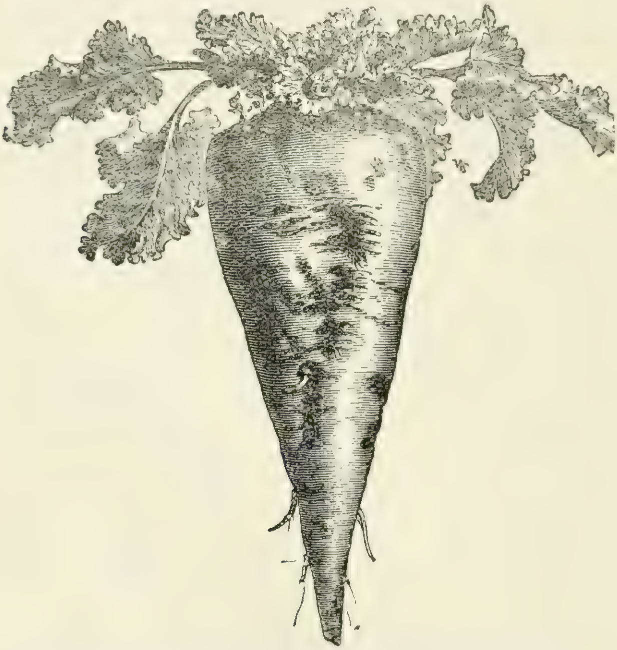


Fig. 1.—Kleinwanzlebener Sugar Beet, Wiley, Farmers' Bulletin 52, United States Department of Agriculture.

To guard against such mistakes, the Experiment Station required the name of the variety of beet used in the experiment. Another object to be secured in knowing the name of the beet in each experiment is to find what kind of beets will give the largest product of sugar and the largest average yield of beets on any kind of soil, or in any district. This information will be of value to the farmer and also to the manufacturer. The Station tries to gather valuable information, not simply to gratify curiosity, and hence has insisted on the name of the beet.

We have two kinds of sugar beets of such uniform excellence, and character so fixed by long cultivation, that it would seem unnecessary for the farmer to use other kinds in experimental trials. First in this class is the well known German beet, Kleinwanzlebener. Three varieties of this beet have been raised on the College farm this year, and a cut kindly furnished by the Department of Agriculture, at Washington, D. C. (Fig. 1), fairly represents a typical specimen of one of them.

The typical form of the sugar beet is a slim cone, well covered by the soil during growth, and with fine, hair-like roots given off from opposite sides.

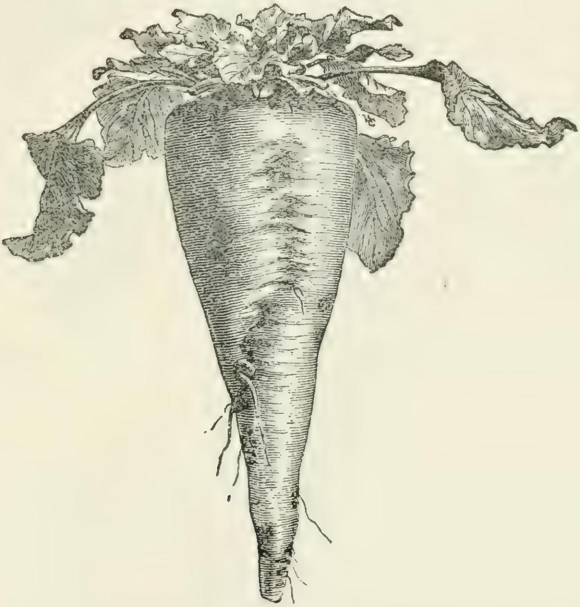


Fig. 2.—White Improved Vilmorin Sugar Beet, Wiley, Farmers' Bulletin 52, United States Department of Agriculture.

The other beet is the Vilmorin (Fig. 3), the favorite sugar beet in France. This is a beet of high quality for manufacturing purposes. In comparing these two varieties of beets with each other, a slight difference is found in favor of the Vilmorin, the average per cent of sugar in 1897 in three hundred and thirty-one samples of Kleinwanzlebener was 16.40, and in 81 samples of Vilmorin was 16.50, showing an average difference of only one-tenth of a per cent this year. In the trials in 1891, the season being less favorable for sugar beet production, fifty-eight samples of Kleinwanzlebener showed an average percentage of sugar of 13.86, while forty-six samples of Vilmorin showed 14.22, a difference of thirty-six hundredths of a per cent in favor of the Vilmorin. The differences in the coefficient of purity between the two varieties in the two years were equally trifling. No one will make a serious mistake by planting either of these sugar beets.

A cut of another sugar beet that is attracting much notice, the Le Plus Riche is here inserted. It has a fine form, and is a vigorous grower. Samples of this beet grown on the College farm this year showed 18.78 per cent of sugar. It seemed to be a beet of good promise and appropriately called The Very Rich.

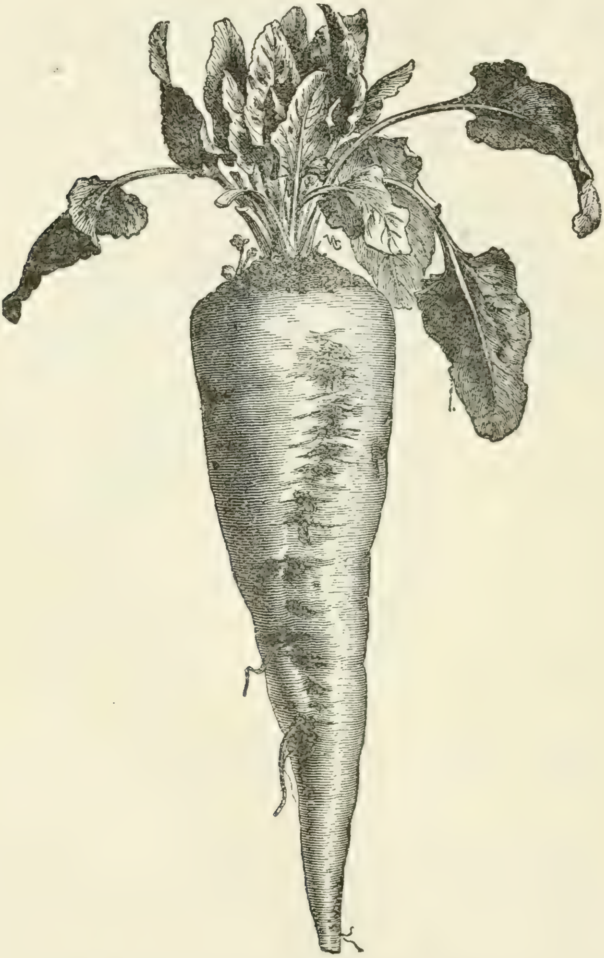


Fig. 3.—White French Rich Sugar Beet, Wiley, Farmers' Bulletin No. 52, United States Department of Agriculture.

PAST WORK OF THE STATION.

The Station has already published two bulletins on subjects relating to the growing of sugar beets and the adaptation of the soil and climate of Michigan to the crop. Both bulletins were issued by the Chemical Department. Bulletin 71, sent out in February, 1891, after showing by charts that the climate of Michigan was as well adapted to sugar beet growing as that of Halle, in Germany, and Cambrai, in France, gave full directions, first for the selection of suitable plots in which to grow experimental areas of the roots, and secondly for the cultivation and harvesting of the crop.

In Bulletin 82, the results of the investigation carried on by the Station in the season of 1891 are set forth. Sixteen hundred pounds of selected seed were imported from France and distributed in large or small packages to any one who applied and promised to plant the seed and cultivate the beets according to the printed directions, and to furnish a report of the results of the trial, with sample beets for analysis, to the Station at the end of the season. Seed was sent to nearly four hundred persons with full directions for planting and cultivating and a form for the report. Two hundred and twenty-eight samples were analyzed and the reports given in the bulletin. The weather for the season of 1891 was characterized by a warm and dry April and May, a cool June, a very cold and dry July, a cold August with plenty of rain, and a warm September. The heat and cold were badly distributed for the beet crop, which suffered also from the unusually prolonged midsummer drouth. As a result the records show variations in per cent of sugar from 13.14 to 16.09, and in coefficient of purity from 71 to 98.5, but averaging not far from 80. The reported yields per acre were from 13.5 to 15 tons.

Considering the character of the season and the complete inexperience of the farmers, the results were far from discouraging.

INVESTIGATIONS IN 1897.

In March, 1897, five hundred pounds of sugar beet seed were received from the Department of Agriculture, Washington, D. C., and late in April a second consignment of two hundred pounds from the same source arrived for distribution. The Station was charged with the duty of trying such experiments on the home grounds as were deemed wise and most helpful to a decision of the questions relating to the adaptability of the soils and climate of Michigan to the production of sugar beets rich in sugar, and with the farther duty of distributing the beet seed, received from the department, to such farmers as would plant and care for the crop as directed by the officers of the Station and would later send in representative beets for analysis, accompanied by a full report of the essential facts of the cultivation and yields.

The report of the work of the season divides itself naturally into two parts, experiments at the Station and tests made by the farmers throughout the State.

EXPERIMENTS AT THE STATION.

Plots. Four one acre plots were selected for the sugar beet experiments on the level, well drained tract of sandy loam in the western half of Field 6, of the College farm. These acre plots are thirty-six rods north and south by seventy-three and one-third feet east and west. Plot 8, the one of the series farthest west, was plowed and subsoiled April 17. The plowing was done with an ordinary hand plow, which was followed immediately by a subsoil plow (Fig. 4), which loosened the ground to a depth of sixteen inches. The hand plow cut a furrow twelve inches wide and eight inches deep. The subsoil plow loosened the soil eight to ten inches below the bottom of the furrow made by the hand plow, but did not move it from its place. The next furrow of the hand plow covered this loosened dirt without mixing the soil and subsoil.

The field had been in corn the year before, planted on an inverted timothy sod which had been covered with a heavy coat of manure in the fall of 1895. The field had been a meadow for the years 1893, 1894 and 1895.

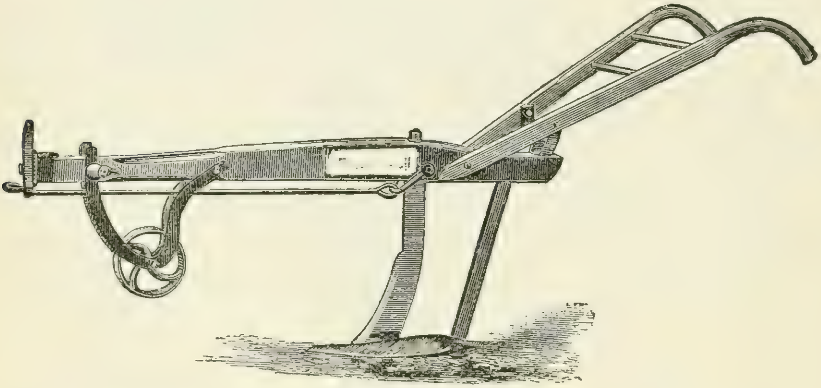


Fig. 4.—Subsoil Plow, Wiley, Farmers' Bulletin No. 52, United States Department of Agriculture.

Plots 9, 10, 11 and 12, lying parallel to Plot 8 and adjacent to it on the east, were plowed and subsoiled on April 19 and 20. The amount of time spent in plowing and subsoiling these plots was six hours with two men and two teams, or twelve hours for one man and team, per plot. Rain fell almost continuously from April 22 to May 5. On May 7, the plots were harrowed thoroughly with a spring tooth harrow and later with a lighter slanting tooth harrow, until the ground was in as fine tilth as could be desired for an ideal garden. It was then marked in rows twenty-two inches apart and perfectly straight. On May 8, the beet seed was planted with a Planet Jr. garden drill (Fig. 5) as follows:

Plot 8, west eighteen rows, 6¼ lbs., Wohanka seed.
Plot 8, next twenty-two rows, 7¼ lbs., Kleinwanzlebener.
Plot 9, west thirty rows, 9.8 lbs., Original Kleinwanzlebener.
Plot 9, next ten rows, 3.5 lbs., Government Kleinwanzlebener.
Plot 10, west thirty-two rows, 9 lbs., Vilmorin's Improved La Plus Riche.
Plot 10, remaining eight rows, 4 lbs., Government Kleinwanzlebener.
Plot 11, forty rows, 13.7 lbs., Government Kleinwanzlebener.

Between thirteen and fourteen pounds of seed per acre were used that there might be no breaks or vacant spaces in the rows. It has been found difficult, if not impossible, to successfully transplant beets to fill up gaps. Experience in sections where the industry has been pursued for several years has demonstrated that it is much more economical to sow the seed thick at the outset and remove all surplus beets at the time of thinning, when the beets are showing the fourth leaf, than to attempt to save seed by thinner sowing.

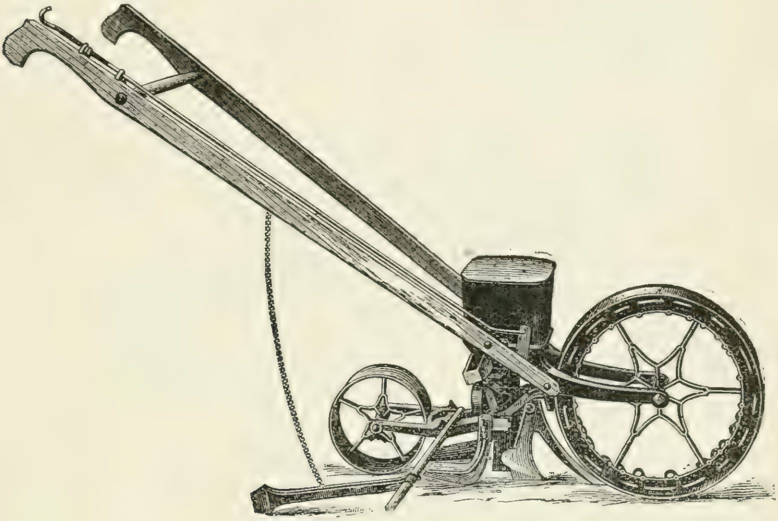


Fig. 5.—Planet Jr , Garden Drill, Wiley, Farmers' Bulletin No. 52, | United States Department of Agriculture.

Cultivation began May 17, before the plants had appeared above the surface of the ground. All the plots were gone over at that time with a Breed's weeder, which served the double purpose of killing the germinating weeds and stirring up the soft, shallow mulch needed to prevent the escape of moisture.

On the first of June all plots were cultivated with Planet Jr., one-horse cultivators. This cultivation was repeated June 12 and June 21. By the latter date the beets were showing the fourth leaf with roots as large as a wheat straw. The thinning was therefore done immediately after the cultivation June 21. By means of a sharp hoe, a large share of the surplus beets were removed from each row, leaving bunches of plants eight or nine inches apart from center to center. Men and boys followed on their knees and removed from these bunches all but the strongest plants. In this way, after the thinning, there was on the average one beet every eight inches in the row, and the rows were twenty-two inches apart. To leave the beets closer together is to grow too small roots. To thin them to a greater distance apart is to invite the growth of large specimens with a low per cent of sugar. Thinning by hand is an arduous and extremely disagreeable undertaking, but under present conditions is absolutely necessary. Nothing has been invented that can take the place of the human eye and the human hand in selecting from a thickly growing bunch of beets the strong plant to be left growing.

The time spent in thinning the four acre plots was as follows:

Plot 8—85.5 hours.
Plot 9—81.5 hours.
Plot 10—70.0 hours.
Plot 11—86.0 hours.

This difference in the time required to thin and weed the beets was due to the fact that Plots 8 and 11 were much worse infested with grass and weeds than the other two acres.

A half acre of sugar beets grown by Bert Cook of Owosso, Mich., on a fall plowed clay loam, following oats in '96, corn in '95, and clover in '94, with the ground thoroughly fitted with a cutaway harrow, followed by an Acme, and cultivated with a Breed's weeder twice before thinning, required forty-four hours labor to do the thinning for the half acre, or at the rate of eighty-eight hours per acre.

No attempts were made to fill up gaps by transplanting as the seed had been evenly scattered and few gaps longer than eight inches to a foot were found.

Nothing farther in the way of cultivation was done to the crop after the thinning. The mean temperature and rainfall by weeks during the season are shown in the following table:

Mean Weekly Temperature and Weekly Rainfall from May 1, to October 22, 1897.

Week ending	Mean temperature.	Rainfall. In.
May 7	51	1.45
May 14	65	.22
May 21	60	1.07
May 28	54	.45
June 4	56	.53
June 11	59	.69
June 18	70	1.10
June 25	66	.05
July 2	72	.30
July 9	82	.00
July 16	69	2.61
July 23	72	1.24
July 30	72	4.34
August 6	71	.88
August 13	71	.23
August 20	62	.46
August 27	65	.10
September 3	65	.56
September 10	74	.00
September 17	69	.35
September 24	56	.00
October 1	58	.00
October 8	57	.16
October 15	58	1.22
October 22	51	.61

The season was unusually cool and wet. July was so very wet that it was impossible to get on the beet field with a cultivator. In August, the showers were fairly well distributed and the crop suffered from no lack of moisture. September was warm with almost continuous sunshine, giving just the conditions required to develop the sugar in the beets. The second week in October was wet and the days following warm and murky. It was necessary therefore to harvest the beets at once to prevent a second growth and a consequent lessening of the per cent of sugar.

The deep preparation of the ground and subsequent thorough cultivation up to the time of thinning had left the soil in such fine tilth that the beets grew well below the surface as shown in the annexed cut (Fig. 6). The importance of this matter of having the soil soft and porous to a good depth cannot be exaggerated. In some parts of the plots the hard subsoil was not thoroughly broken up by the subsoil plow. In these places the beets, instead of having the desired long conical form, were short and almost spherical in general contour, with large branching roots. Such beets would not be received by a factory, and would therefore be worthless in the hands of the farmer growing the crop for sugar making purposes.

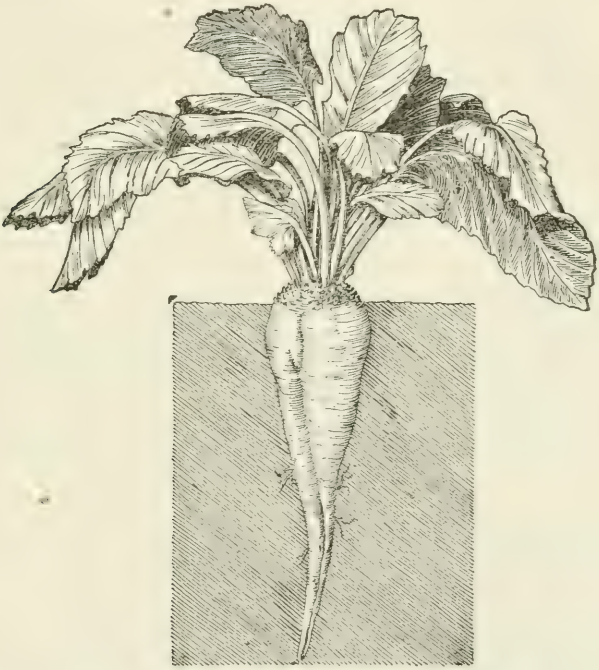


Fig. 6.—Correct position of a mature beet in the soil. Wiley, Farmers' Bulletin, 52, United States Department of Agriculture.

The beets were harvested October 16. A plow was run alongside each row and close to it, throwing the soil away and leaving the beets standing on the very edge of the furrow. The beets were then pulled by hand, the tops wrenched off and the roots thrown in piles, which were weighed and hauled to the pit to be stored for winter feeding. Owing to the deep subsoiling and thorough preparation of the ground, the roots were found to have grown almost entirely covered with soil, the tops alone above the surface. Few beets exceeded three pounds in weight and the bulk of the crop averaged not far from two and one-half pounds. The time required for harvesting was, per acre, 4.6 hours for man and team, and 130.75 hours for a man.

The total amount of labor expended on the beets is summed up in the following table, which gives separately the hours of team and hand work per acre:

	Man and team. Hours.	Man. Hours.
Plowing and subsoiling	12.	
Harrowing	3.75	
Marking	.8	
Planting		3.25
Cultivating	15.	
Thinning and hoeing		75.90
Harvesting	4.60	130.75
Total time per acre	36.15	209.90

The hand labor in harvesting was performed by boys at eight cents an hour. The 79.15 hours spent in hoeing and thinning was done by men at twelve and one-half cents an hour. The team work is reckoned at twenty-five cents an hour for man and team. At these prices the cost of labor for growing an acre of beets was $29.40.

The yield of the beets by varieties and by acre plots was as follows:

	Pounds.
Plot 8, Wohanka, .45 acre	10,627
" " Kleinwanzlebener Improved, .55 acre	14,123
Total for Plot 8	24,750
Plot 9, Original Kleinwanzlebener, .75 acre	20,523
" " Government Kleinwanzlebener, .25 acre	6,412
Total for Plot 9	26,935
Plot 10, La Plus Riche, .80 acre	23,364
" " Government Kleinwanzlebener, .20 acre	5,904
Total for Plot 10	29,268
Plot 11, Government Kleinwanzlebener, 1 acre	32,327

Average yield per acre, 28,328 pounds.

Below is given the average yield per acre by varieties, with the per cent of sugar and the coefficient of purity:

Variety.	Yield per acre, pounds.	Per cent sugar.	Purity.
Wohanka	23,615	15.22	86
Improved Kleinwanzlebener	25,678	16.40	91
Original Kleinwanzlebener	27,368	18.27	94
Government Kleinwanzlebener	25,618	17.78	94
La Plus Riche	29,205	18.78	92
Government Kleinwanzlebener	32,327	17.78	94
Hoerning's Improved	24,500	15.20	89
Floto's Improved	20,200	13.21	88
Kleinwanzlebener on muck	----------	12.96	75

Hoerning's Improved Kleinwanzlebener seed was received from Edmund Stark, Grand Island, Neb., and was sown on Plot 12, the acre east of Plot 11 and adjacent to it. The seed arrived late and was sown May 18 and 22.

The Floto's Improved Beet seed was donated to the Station by the Wernich Seed Co., Milwaukee, Wis., arrived late, and was sown May 22, in rows parallel to the acre plots and east of them 12 rods.

Experiments were planned to test the relative values of commercial fertilizers and of certain mineral salts on the growth of sugar beets, but the crop was so badly injured by a fungus disease (*Cercospora beticola*) as to invalidate the results. The addition of mineral manures did in general increase the yield, but accurate results cannot be given because of the invasion of this disease.

REPORTS OF EXPERIMENTS MADE BY FARMERS AND RESULTS OF ANALYSES OF THE SUGAR BEETS.

On the receipt of notice from the Department at Washington that sugar beet seed was to be sent to the station for distribution, letters were written to a large number of farmers, several in nearly all of the counties of the lower peninsula, explaining the nature of the proposed experiments and asking cooperation in the solution of the questions relating to the quantity and quality of sugar beets that Michigan could produce. Four hundred and sixty-six separate shipments of seed were made. A single shipment went often to several farmers, there being the names of four hundred and eighty-nine farmers on the list of those who received seed from the Station. To several places, notably Saginaw, Port Huron, Sand Beach, and a few others, amounts of seed were sent in bulk and distributed by persons appointed for that purpose by the Station.

From time to time during the season special bulletins were issued and sent to the beet growers outlining the correct methods of planting, caring for and harvesting the crop. By private letters, by special publications and by articles in the newspapers, the officers of the Station called attention to the necessity of thorough preparation of the ground, of thick sowing, of early and frequent cultivation, of thinning at the right time and in the right way, and finally to the method of harvesting to insure an accurate report of the results to the Station.

Four hundred and eighty-four samples have been sent to the Station for analysis from points outside of the College farm. The available results from these samples and reports of the experimenters, together with the results of the analyses of the beets are presented in the following table, giving by counties the name and residence of each experimenter with as full a report of the conditions of the experiment as the Station could procure, and the results of the analysis of each sample.

This table is given to the public in the hope that it will be of interest and benefit to the people of our State, and especially to those localities where the samples were raised. The table does not include the report of all the samples sent to the Station. Some have been omitted because the precise points which chiefly gave valuable information to the public were omitted, when sending the samples. This information was solicited often by a personal letter sent out after the receipt of the beets, yet was not furnished. Other reports have been omitted either because the beets were sent without the name or residence of the experimenter, or because the beets sent were dried and shriveled, and on that account no fair conclusion as to their value could be drawn from the analysis. With these exceptions, every sample of sugar beets sent to the Station has been analyzed and reported.

In the table there is included the report of the analyses of the sugar beets grown on the Station farm. Reports of analysis have not been sent, to the persons forwarding beets, prior to the publication of this bulletin, because of the pressure of other duties on Station officers. The work has been pushed as rapidly as possible to let all parties know of the outcome of the experiment.

Results of cultivation of sugar beets in Michigan in 1897, with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	Variety of sugar beet.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
1	Higgins & Lenders, 323B	Saginaw	Kleinwanzlebener	Muck	43		8.81	72
2	" " " 97A	"	Vilmorin	Sandy loam	30	24	17.07	89
3	" " " 60A	"	Kleinwanzlebener	Clay loam	40	34	17.13	84
4	" " " 90A	"	"	Sandy clay	24	37	18.07	92
5	" " " 572	"	Wohanka	Sandy loam	19	90	16.54	86
6	" " " 458A	"	Kleinwanzlebener, Original	Black loam	34	32⅓	17 49	83
7	" " " 498B	"	"	Sandy	26	10	18.06	92
8	" " " 573	"	"	Clay loam	20	26	15.00	81
9	" " " 482A	"	Vilmorin	Sandy loam	29	26	15.02	87
10	" " " 575	"	Kleinwanzlebener	" "	19	40	12.07	85
11	" " " 577	"	"	" "	19	32½	13.44	81
12	" " " 579	"	Wohanka Extrareichen	Sandy	16	63⅓	13.58	80
13	" " " 576	"	Wohanka	Sandy loam	27	90	17.07	85
14	" " " 579	"	Kleinwanzlebener	" "	29	63⅓	14.86	81
15	" " " 374B	"	"	Sandy	43	37¾	16 54	89
16	" " " 578	"	Wohanka	"	19	81⅓	13 99	81
17	" " " 574	"	Kleinwanzlebener	Sandy loam	34	94	15.85	86
18	" " " 90B	"	"	Sandy clay	20	38	18.06	88
19	" " " 53B	"	"	Clay loam	24	34	14.74	86
20	" " " 286A	"	"	Black clay	16	31	16 11	87
21	" " " 105A	"	Vilmorin	Sandy clay	20		14 57	80
22	" " " 122B	"	Kleinwanzlebener, Original	Sandy loam	30	22⅓	16.73	88
23	" " " 339A	"	Vilmorin	" "	22	28	15.90	87
24	" " " 492B	"	"	" "	24	26	16.42	89
25	" " " 363A	"	Kleinwanzlebener	Clay	30	37	13.30	80
26	" " " 115B	"	Vilmorin	"	36		17.58	87
27	" " " 373B	"	"	Sandy loam	33	24	16.31	84
28	" " " 17A	"	Kleinwanzlebener		21	40	16.02	86
29	" " " 78A	"	Vilmorin		30	35	18 07	86
30	" " " 286B	"	Kleinwanzlebener	Clay loam	18	31	16.51	89
31	" " " 116B	"	"	" "	24		16.05	87
32	" " " 458B	"	" Original	Black loam	31		18 81	87
33	" " " 57A	"	"	Yellow clay	28	20⅓	16.02	80
34	" " " 198A	"	Vilmorin	Black loam	23	33½	11.87	74
35	" " " 115B	"	"	Clay and sandy loam	28	52⅓	15.90	86
36	" " " 332	"	Kleinwanzlebener	Sandy loam and muck	31		14.42	79
37	" " " 210A	"	"	Sandy	30	56	13.47	79
38	" " " 562B	"	Vilmorin	Clay	32	27	16.05	84
39	" " " 73A	"	Kleinwanzlebener	"	31	33⅓	13.99	80

Results of cultivation of sugar beets in Michigan in 1897, with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	Variety of sugar beet.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
40	Higgins & Lenders, 498A	Saginaw	Kleinwanzlebener	Sandy	37	23	16.99	84
41	" " " 562A	"	Vilmorin	Clay loam	30	30½	13.44	76
42	" " " 482B	"	Kleinwanzlebener	Clay and sand	40		16 54	84
43	" " " 569A	"	Vilmorin	Black sand	23	22¾	16.67	80
44	" " " 192B	"	Kleinwanzlebener	Black sandy loam	25	22¾	17.05	88
45	" " " 389A	"	"	Very poor	27	24	15.75	82
46	" " " 248B	"	"	Blue clay	34	23	17.07	82
47	" " " 199A	"	Vilmorin	Sandy loam	23	30	15.13	88
48	" " " 502A	"	Kleinwanzlebener	Clay loam	26	29	14.16	83
49	" " " 105B	"	Vilmorin	" "	25	18½	17.32	86
50	" " " 241B	"	Kleinwanzlebener	" "	34	19	13.02	80
51	" " " 210B	"	"	Sandy	16	20½	14.62	80
52	" " " 327B	"	Vilmorin	Black sand	40	40	16 02	90
53	" " " 3A	"	Kleinwanzlebener	Sand and clay	24	35	17.07	88
54	" " " 249A	"	"	Clay loam	32	18½	15.96	81
55	" " " 69B	"	"	Sandy loam	30	45	17.69	85
56	" " " 506B	"	"	Black sand	26	20	15.13	84
57	" " " 192A	"	"	" "	25	40	15.35	87
58	" " " 523B	"	"	Black sandy soil	19	13½	18.06	88
59	" " " 375A	"	"	Sandy loam	36	24	16 31	86
60	" " " 287B	"	Vilmorin	Mixed ground	20	31	17.49	86
61	" " " 501	"	Kleinwanzlebener	Clay loam	23	18½	19.15	86
62	" " " 3B	"	"	Sand and clay	21	35	16.05	80
63	" " " 497B	"	"	Sandy loam	44	29	15.35	85
64	" " " 248	"	"	Blue clay	24	23	18.83	87
65	" " " 46B	"	"	Sandy loam	21	22½	15.85	84
66	" " " 71	"	"	Sand and clay	32	20	16.67	85
67	" " " 85	"	"	Clay loam	25	16½	17 38	84
68	" " " 93B	"	Vilmorin	" "	20	71½?	22 33	91
69	" " " 249	"	Kleinwanzlebener	Clay	28	18½	15.87	86
70	" " " 288A	"	"	Hard clay	20	28½	14.94	79
71	" " " 122A	"	" Original	Sandy loam	21	21½	17.43	88
72	" " " 340B	"	Vilmorin	Dark loam	39	21	16.56	84
73	" " " 523	"	Kleinwanzlebener	Black sand	35	13½	14.42	84
74	" " " 3	"	"		28	35	18.32	85
75	" " " 531	"	"	Sandy	26	27	17.24	82
76	" " " 57B	"	"	Yellow clay	37	20	16.11	82
77	" " " 387	"	"	Sandy	30	25½	17.49	85
78	" " " 298	"	"	"	28	12½	10.31	73

79	" " "	569B	"	Vilmorin	Black sand	19	37¾	18.94	92
80	" " "	25B	"	"	Black loam	24	10¾	20.98	89
81	" " "	60B	"	Kleinwanzlebener	Clay loam	33	34	17.83	82
82	" " "	97B	"	Vilmorin	Sandy loam	38	24	17.05	88
83	" " "	116A	"	Kleinwanzlebener	Clay loam	37	33½	16.22	85
84	" " "	120A	"	Vilmorin	Sandy loam	30	18⅛	16.02	81
85	" " "	90	"	Kleinwanzlebener	" "	20	38	19.58	88
86	" " "	120B	"	Vilmorin	" "	27	18⅛	20.18	88
87	" " "	322B	"	Kleinwanzlebener	Muck	40	18½	16.54	75
88	" " "	288A	"	"	Hard clay	23	28½	14.16	75
89	" " "	33A	"	"	Clay loam	35	34	18.30	86
90	" " "	198B	"	Vilmorin	Black loam	32	33½	13 72	76
91	" " "	8A	"	Kleinwanzlebener	Sandy	32	30	21.22	90
92	" " "	199B	"	Vilmorin	Sandy loam	21	30	16.62	89
93	" " "	23A	"	"	Clay	31	39⅛	13 58	80
94	" " "	363B	"	Kleinwanzlebener	"	28	-----	15.25	83
95	" " "	507B	"	"	Black muck	28	25¾	14.31	75
96	" " "	497A	"	"	Sandy	30	29	15.90	86
97	" " "	298A	"	"	Sandy loam	20	12½	11.27	70
98	" " "	298B	"	"	" "	29	12⅛	17.30	85
99	" " "	93	"	Vilmorin	Clay loam	20	71½?	19.99	88
100	" " "	565	"	Kleinwanzlebener	-----	22	-----	16.19	86
101	" " "	457	"	"	-----	33	39	12.75	77
102	" " "	507B	"	"	Muck	28	25¾	13.80	83
103	" " "	69	"	"	Sandy loam	24	45	14.94	79
104	" " "	559B	"	Vilmorin	" "	25	25	17.07	83
105	" " "	531D	"	"	Loose and mellow	23	27	20.92	88
106	" " "	559B	"	"	Sandy loam	24	25	15.85	87
107	" " "	23B	"	"	Clay soil	32	40	11.87	70
108	" " "	210A	"	Kleinwanzlebener	Sandy	22	56 ?	15.35	87
109	" " "	339B	"	Vilmorin	Sandy loam	20	28	16 81	83
110	" " "	8B	"	Kleinwanzlebener	Sandy	35	30	18.18	88
111	" " "	62A	"	"	Clay loam	28	22⅛	13.13	79
112	" " "	531B	"	"	Loose and mellow	27	27	20.67	89
113	" " "	502B	"	"	Clay loam	34	29	15.75	87
114	" " "	340A	"	Vilmorin	Dark loam	33	27½	13.70	80
130	" " "	385-8	"	From Chino Valley	Sandy	33	23	19.50	87
131	" " "	379-2	"	Vilmorin	"	26	34	14.87	81
132	" " "	380-3	"	Blabotier	"	40	30	16.83	84
133	" " "	384-7	"	Vilmorin	"	24	25	16.31	86
134	" " "	382-5	"	Kleinwanzlebener, Original	"	28	26	13.32	80
135	" " "	386-9	"	Wohanka	"	38	34	15.00	85
136	" " "	379-1	"	From Department Agriculture	"	34	28	13.19	82
137	" " "	383-6	"	Kleinwanzlebener	"	31	28	16.05	87
138	" " "	381-4	"	Wohanka Extrareichen	"	31	25	11.54	80
140	Robert Spence		Prost	Kleinwanzlebener	Clay loam	35	-----	14.36	81
343	John Nason		Chesaning	"	Prairie loam	29	28	15.19	82
364	A. G. Conger		Brady	"	Black loam	33	-----	15.64	79
346	J. G. Hickinger, Jr.		Frankenmuth	"	-----	26	-----	19.58	90

Results of cultivation of sugar beets in Michigan in 1897 with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	County.	Variety of sugar beets.	Kind of soil	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
210	E. H. Marsh	Alpena	Alpena	Kleinwanzlebener	Clay loam	33	14	13.27	80
337	Joseph Bryan	Orchard Hill	"	"	Sandy loam	40	12⅙	16.75	80
155	Chas. Johnson	Rock River	Alger	"	Meadow bottom	10	10	14.22	80
218	Peter Gilbert	Sterling	Arenac	White Silesian	Sandy loam	28	7	13.85	77
	W. J. Wademan	Twining	"	Vilmorin		21		14.33	80
219	Dean W. Thrasher	Standish	"	Kleinwanzlebener	Deep sandy loam	18	26	17.27	86
197	Thos. Turner	Melita	"	"	Clay loam	28	15½	16.05	86
151	Frank Philips	Saganing	"	White Sugar	Sandy loam	17	?	16.82	86
183	Orville Brooks	"	"	"Sugar Beet"		28		16.08	87
336	W. S. Lloyd	"	"	"Congressional"	Clay loam	14	14	19.06	90
342	Richard W. Lloyd	"	"	"	Sandy loam	17	12	20.73	90
188	C. V. Nash	Cheshire	Allegan	Kleinwanzlebener	" "	27	13	15.02	87
198	T. G. Adams	Shelbyville	"	"	" "	25	?	16.28	88
271	Franklin D. McVean	Monteith	"	"	" "	25	16	15.70	84
180	Robert Campbell	Mancelona	Antrim	"	Sandy	18	15	15.16	82
217	Fred Pfeiffer	Elk Rapids	"	"	"	21	20	16.79	82
126	C. B. Chatfield	Bay City	Bay	Vilmorin	Sandy loam	24	15	18.07	88
184	Andrew Faulds	Bentley	"	Kleinwanzlebener	Black sandy loam	31	?	11.33	81
202	Anthony Reder	Auburn	"	"	Heavy sand	56	15	16.93	90
203	Wm. Bentley & Sons	Bay City	"	Vilmorin		28		16.54	81
204	" " "	" "	"	"		22		16.36	84
205	" " "	" "	"	Imperial		22		13.47	80
206	" " "	" "	"	Vilmorin		25		14.22	80
253	Frank Rossman	" "	"			23		14.25	79
339	Bay County Land Office	" "	"	White Silesian	Black sandy soil	30	14	17.75	88
404	John B. Bushey	Auburn	"	Kleinwanzlebener	Dark sand	32	9	16.42	85
229	D. E. Groesbeck	Union City	Branch	"	Clay sand	19	?	18.07	84
256	Warren Boughton	Bronson	"	From Dept. of Agriculture	Sandy soil	21	17	17.55	85
413	E. F. Boughton	"	"	Wohanka	Sandy loam	26	25	14.25	82
335	John L. McKernan	L'Anse	Baraga	Kleinwanzlebener	" "	27	23	14.10	76
175	T. R. Chambers	Irving	Barry	"	" "	25	43½?	13.92	75
215	J. V. Bray	Middleville	"	"	Gravelly loam	44	14½	14.94	80
245	John E. Murphy	Bower's Mills	"	"	Sandy loam	27		16.48	88
258	C. E. Paul	Gaskill	"	"	Clay loam	28	15	14.25	82
272	Mrs. L. F. Moore	Coloma	Berrien	"	Sandy loam	28	?	19.64	85
150	Arno Hall	Watervliet	"	"	Light sandy loam	16	?	17.58	89
158	B. F. White	"	"	Vilmorin Imperial	Sand and gravel	17	15⅙	16.28	88
222	E. C. Hinman	Battle Creek	Calhoun	"Seed from Chino, Cal."	Sandy soil	30	27	13.99	80

231	Dennis McAllister	Penfield	“	Kleinwanzlebener	Sandy loam	33	14	17.81	87
239	Gilbert Nichols	Battle Creek	“	“	“ “	20		19 58	88
233	C. C. McDermid	“ “	“	“	“ “	22	9	14.94	84
377	Thos. E. Haddon	Bedford	“	“	“ “	27		12.49	77
235	T. L. Johnson	“	“	“	Sandy	43		16.11	87
228	H. S. McMaster	Dowagiac	Cass	Department of Agriculture	Sandy loam	24	15	15.02	87
128	M. J. Gard	Volinia	“	Kleinwanzlebener	Prairie	26	13¼	15.86	77
181	Geo. Smallet	Boyne	Charlevoix	“	Sandy loam	20	18	19.25	91
199	Jas. Harvey	South Avon	“	“	“ “	21		18.13	90
220	Geo. Anderson	Charlevoix	“	“	Heavy clay	19	35	15 85	77.
221	J. J. Robbins	Boyne Falls	“	“	Gravel loam	29	21	17.75	86
156	John Ward	Charlevoix	“	“	Heavy clay loam	25	28⅛	15 75	85
157	E. B. Ward	“	“	“	Clay loam	25	32	17.58	91
375	Geo. Ball	“	“	“	Sandy	30		18.75	88
171	Ed. Whitney	Clare	Clare	“	Sandy loam	26	20	16.54	88
141	W. H. Faxon	Ovid	Clinton	“	Light sand	29	16	13 91	80
172	Marion Tifft	DeWitt	“	“	Clay loam	18		16.48	88
251	R. B. Caruss	St. Johns	“	“	Sandy loam	29	11	17.75	89
273	A. Matthew	Maple Rapids	“	“	Sand and muck	32	18	15.40	80
209	O. Palmer	Grayling	Crawford	Vilmorin	Sand plains	16	22½	15.25	81
269	Leo V. Hildinger	Woodbury	Eaton	Kleinwanzlebener	Sandy loam	30		19.69	85
281	A. S. Merritt	Eaton Rapids	“	“	Sandy	30	14	17.43	84
186	Jerrie Mikesill	Charlotte	“	“	Clay	32	31	17.08	85
247	Joseph Shaw	“	“	“	Sandy loam	20	13	17.46	84
410	Benj. Shellhorn	Woodbury	“	“	Clay soil	27	30	15.85	79
154	Henry R. Miller	Petoskey	Emmet	“	Clay loam	29		15.02	82
149	D. Henry	Montrose	Genesee	“	Yellow sand	34	43	16.05	86
185	H. B. Latourette	Fenton	“	?	Alluvial bottom	59	?	7.82	71
196	L. J. Harris	Richfield	“	Kleinwanzlebener	Sandy loam	28	21½	18.83	84
200	Chas. W. Shayler	Bentley	“	“	“ “	21		18.13	90
213	A. J. Daumur	Fenton	“	“French White”	Black loam	35	20	12.86	79
201	B. W. Benjamin	Flushing	“	Kleinwanzlebener	Gravelly	27	29	14.83	81
159	Wm. R. Fuller	Fife Lake	Gra'd Traverse	“	Clay and sand loam	25	7½	17.46	86
178	L. S. Walter	“ “	“ “	“	Sandy loam	26	24½	14.34	79
179	G. S. Stalker	Summit City	“ “	“	“ “	19	40?	13.44	79
214	J. B. Brown	Slights	“ “	“	“ “	26	?	17.07	88
216	H. Hoffman	“	“ “	“	“ “	28	?	15.40	82
249	Mrs. H. E. Wilsey	Summit City	“ “	“	Garden soil	29	?	17.75	84
177	Geo. Roush	Traverse City	“ “	“	Muck and sand	25	43?	14.83	80
280	I. N. Cowdrey	Ithaca	Gratiot	“	Clay loam	22	26	14.62	80
306	Geo. C. Titus	t. Louis	“	“	Sand and clay	27	35	18.83	87
313	Ray Fraker	Alma	“	“	Prairie soil	22	12	14 31	79
414	Geo. Gibson	Breckenridge	“	“	Black sandy loam	27	7⅛	15.40	81
129	J. F. Thissell	“	“	“	Sandy loam	14	9¾	19.08	90
297	J. D. McCrimnon	St. Louis	“	“Sugar Beet”	Clay loam	29	?	14.30	80
283	Chas. E. Fuller	Osseo	Hillsdale	Kleinwanzlebener	Dark timber land	28	16	17.30	88

Results of cultivation of sugar beets in Michigan in 1897, with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	County.	Variety of sugar beets.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
4[illegible]5	Chas. Mosher & Son	Mosherville	Hillsdale	Kleinwanzlebener	Heavy sand	20	8½	16.12	80
117	H. S. Worden	Sand Beach	Huron	Vilmorin	Clay loam	20	8¾	19.36	86
89	Bert Baur	Bayport	"	Kleinwanzlebener	" "	29	49 ?	18.65	86
190	John J. Murdock	Pigeon	"	"	" "	21	----	14.74	84
4[illegible]9	John Hoxtable	Sand Beach	"	"	Sand	19	26	18.89	86
421	R. A. Brown	" "	"	Vilmorin	Clay	26	19¼	17.18	85
	Daniel Mooney	Ft. Gratiot	"	"	Clay loam	21	16½	16.00	85
152	R. V. McKeen	Lansing	Ingham	----	----	34	----	15.87	87
182	Milo E. Marsh	"	"	German	Sandy muck	29	34	12.66	76
226	August Dreger	Okemos	"	Gov't Kleinwanzlebener	Rich loam	31	14	16.02	81
293	Peter Karber	"	"	Kleinwanzlebener	Sandy	33	?	17.32	84
373	S. H. Foster	"	"	"	Red sand and clay	14	11	16.28	89
[illegible]97	A. Ferle	Lansing	"	----	----	34	----	10.75	74
4[illegible]6	Leonard Powell	Okemos	"	Kleinwanzlebener	----	45	----	14.94	83
4[illegible]6	Harvey M. Young	Mason	"	"	Clay loam	14	30	18.05	88
1	Plot 1	Agrl. College	"	Gov't Kleinwanzlebener	Sandy loam	17	15	20.52	87
1½	" 1½	" "	"	" "	" "	15	18	17.24	83
2	" 2	" "	"	" "	" "	18	18	17.03	90
2½	" 2½	" "	"	" "	" "	16	14½	20.85	87
...	" 3	" "	"	" "	" "	20	17½	17.50	85
...	" 3½	" "	"	" "	" "	22	18	15.84	84
...	" 4	" "	"	" "	" "	17	15	17.55	87
...	" 4½	" "	"	" "	" "	15	17	16.05	89
...	" 5	" "	"	" "	" "	13	15	14.45	85
...	" 5½	" "	"	" "	" "	13	11	18.03	90
...	" 6	" "	"	" "	" "	14	9½	15.58	91
...	" 6½	" "	"	" "	" "	14	11	17.96	90
...	" 7	" "	"	" "	" "	13	13	17.04	83
...	" 7½	" "	"	" "	" "	12	8½	18.41	90
...	" 8	" "	"	" "	" "	14	10½	15.25	88
...	" 8½	" "	"	" "	" "	13	15	16.25	90
...	" 9	" "	"	" "	" "	14	19¼	17.47	85
...	" 9½	" "	"	" "	" "	14	9	16.05	89
...	" 10	" "	"	" "	" "	13	12	15.99	88
...	" 10½	" "	"	" "	" "	14	16	16.54	87
...	Field Culture	" "	"	Wobanka	Gravelly loam	12	11¾	15.22	86
...	" "	" "	"	Improved Kleinwanzlebener	" "	9	13	16.40	91
...	" "	" "	"	Original Kleinwanzlebener	" "	15	13¾	18.27	

	" "	" "	"	Le Plus Riche	" "	19	14½	18.78	92
	" "	" "	"	Gov't Kleinwanzlebener	" "	11	15½	17.78	94
	" "	" "	"	Floto's Improved	" "	17	10	13.21	88
	" "	" "	"	Kl inwanzlebener	Muck	19		12.96	75
	" "	" "	"	Hoerning's Improved	Gravelly loam	14	12¼	15.20	89
357	F. Greininger	Stambaugh	Iron	Kleinwanzlebener	Sandy	13	27	18.13	80
370	P. A. Wachs	Lake Odessa	Ionia	"	Clay loam	24	14	16.05	82
208	Alex. McKenzie	Campbell	"	"	Clay	25	?	16.73	84
318	P. G. Fellows	Lake Odessa	"	"	Gravelly loam	31	10	15.02	76
366	A. M. Gravella	Smyrna	"	"	Sandy loam	18		17.64	86
248	Leander Bellville	Whittemore	Iosco	"	Sand	37		16.99	88
254	A. Cataline	"	"			42		10.84	78
422	Dr. H. A. Goodale	East Tawas	"	Vilmorin	Sandy soil	14	23½	16.48	85
475	Geo. Putnam	Hale	"	"	Clay	23		16.48	82
476	A. C. Kay	East Tawas	"	Kleinwanzlebener ?	Sand	37		7.96	63
477	" "	" "	"	Vilmorin	"	37		10.31	64
359	Thos. Collin	Mt. Pleasant	Isabella	Kleinwanzlebener	Dark sand	37	18	15.64	85
461	Alexander Meyer	Shepherd	"	"	Black clay	32	50 ?	18.58	86
458	F. C. Dingman	Caldwell	"			29		15.02	76
463	J. E. Meyer	Shepherd	"	Vilmorin Improved ?	Black ?	32	30	7.11	62
176	F. J. Randall	Brooklyn	Jackson	Kleinwanzlebener	Sandy loam	23	18½	16.99	84
191	A. B. Cook Co., No. 3	"	"	?	?	88	?	6.18	68
192	" " " " 4	"	"	?	?	32	?	5.30	63
193	" " " " 5	"	"	?	?	50	?	7.46	74
194	" " " " 2	"	"	?	?	106	?	6.07	65
195	" " " " 1	"	"	?	?	76	?	6.83	70
372	F. J. Randall	"	"	Kleinwanzlebener	Sandy loam	30	18½	19.3[illegible]	92
255	O. E. Clark	Comstock	Kalamazoo		" "	32	19	16.88	88
279	Adam Ehrmann	Kalamazoo	"	Sugar Beet	Clay loam	49	?	13.47	76
282	W. A. Keyser	"	"	Kleinwanzlebener	Gravelly loam	12		16.42	88
284	Geo. D. Cobb	Schoolcraft	"	"	Black muck	12		10.04	77
285	W. A. Brockway	Vicksburg	"	"	Black sandy loam	27	14	15.02	77
287	D. T. Dell	"	"	"	Clay openings	32	22½	16.05	81
288	" "	"	"	"	Timbered openings	23	23	15.08	80
290	G. M. Cheeney	"	"	"	Clay loam	24	14	13.19	76
292	John Williams	Williams	"	"	Sandy loam	24		18.45	89
307	Geo. F. Young	Schoolcraft	"	"	Sand	25		15.64	81
323	L. B. Welch	Portage	"	"	Sandy loam	18	17	16.56	86
326	Leander Cannon	Vicksburg	"	"	Heavy clay loam	33	19½	15.08	77
327	Thos. Hazard	Fulton	"	"	Sandy loam	28	29	16.51	84
334	C. W. Lemon	Vicksburg	"	"	Sandy loam	11	17	16.57	84
369	F. F. Perkins	Climax	"	"	Clay loam	9	10	18.89	90
371	M. F. Woodward	Schoolcraft	"	White French	Sandy loam	27	14½	14.20	80
409	Fred Van Zie	Kalamazoo	"	Kleinwanzlebener	Black muck	28		15.97	84
325	H. E. Hagan	South Boardman	Kalkaska	"	Plains	24	26	15.[illegible]9	80
400	C. A. Goddard	Kalkaska		"	Pine plains	26	11	18.64	87

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Lab. No.	Name.	Locality.	County.	Variety of sugar beets.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
319	M. M. Thomas	Cedar Springs	Kent	Kleinwanzlebener	Sandy	21	24	18 83	91
320	Robt. S. Sowerby	Rockford	"	"	Sandy loam	29	15	16.88	85
322	C. Thomas	Cedar Springs	"	"	Sandy	16	21½	11.90	73
332	Hart Bradish	Grand Rapids	"	"	Clay loam	27		13.99	75
338	John E. Hoag	Cannonsburg	"	"	Sandy	15	43	15.96	85
339	D. C. Hooper	Logan	"	"	Clay loam	29	13½	16.28	84
350	W. H. Zylstra	Fisher's Station	"			31	20	16.92	87
368	E. L. Phelps	Cedar Springs	"	Kleinwanzlebener	Clay	37	26	15.96	85
374	Samuel R. Miller	Kent City	"	"	Sandy loam	24	17	11.90	79
388	David C. McLain	Edgerton	"	"	" "	26	17	16.31	85
395	J. K. Hilton	Ross	"	"	Muck	28	39	13.91	80
402	Nate Emmory	Kent City	"	"	Sand	11	?	17.81	86
407	Chas. Ennis	Cedar Springs	"	"	Sandy loam	12	21½	16.73	88
445	A. B. Fenton	Bradley	"	White Skin from Dept. Agr.	Reclaimed muck	20		12.16	77
451	John F. Nellist	Grand Rapids	"		Loose gravel	20	12	14.94	79
139	Geo. H. Miller	Ada	"	Kleinwanzlebener	Clay loam	17	24¼	16.13	87
278	W. H. Stickney & Sons	Lapeer	Lapeer	"	Black clay loam	34	14	17.24	80
314	F. S. Porter	North Branch	"	"	Gravelly loam	15	19.5	18.18	88
312	Semira Tremain	Norrisville	Leelanaw	"	Sandy	23	5	19.25	89
444	August Kurtzhals	Good Harbor	"	"	Sandy loam	24	13½	19.88	88
383	Wm. Bruff	Oviatt	"	"	" "	24	20	17.18	90
259	Walter Clement	Adrian	Lenawee	French White	Sandy	23	15	12.60	84
260	" "	"	"	Vilmorin Imperial	"	15	15	17.07	86
261	" "	"	"	Kleinwanzlebener	"	19	15	18.07	88
262	" "	"	"	Congressional	"	20	15	16.79	88
379	R. S. Gillespie	Tecumseh	"	Kleinwanzlebener	Black sandy loam	30	18	15.29	80
324	Guy G. Bordon	Howell	Livingston	"	Gravel loam	21	28	14 94	80
330	Geo. Stowe	Unadilla	"	"	Sandy loam	24	31	13.74	80
363	John R. Pollock	Hessel	Mackinac	White Silesian	" "	88	13½	16.22	85
115	C. Patterson	Richmond	Macomb	Vilmorin	Clay loam	23		18.00	82
122	Lawrence Hosmer	Romeo	"	"	Sandy loam	23	18	19.08	86
	J. P. Martz	Mt. Clemens	"			53		13.21	78
123	C. A. Hulbert	Armada	"		Clay loam	31	60 ?	9.47	67
153	Bruce Phillips	Utica	"	Kleinwanzlebener	Muck and sand	31	48 ?	15.70	87
276	Wm. C. Smith	Washington	"	"	Black clay loam	22	11¼	17.94	88
309	Jas. S. Lawson	Disco	"	"	Heavy sand	17	19	14.51	83
432	H. A. Keeler	Richmond	"	Vilmorin	Clay loam	14	22½	22.44	92
398	L. D. Whitney	Mt. Clemens	"	Kleinwanzlebener	Sandy loam	17	13	14.05	81

423	Joseph Dunsmore	Memphis	"	"		20		16.42	80
	D. F. Dysinger	"	"	Vilmorin		17		16.50	82
384	J. D. Maxted	Chief	Manistee	Kleinwanzlebener	Clay	19	57 ?	15.64	85
361	Hiram E. Scott	Manistee	"	"	Light sand	8	9	13.47	80
401	C. D. McMartin	Tanner	"	Congressional	Gravelly	23	28	18.89	87
298	Buckley & Douglas Lum. Co.	Manistee	"	Kleinwanzlebener	Sandy loam	29	18⅛	20.92	91
460	A. W. Farr	Onekama	"	"	" "	52	15	15.40	81
468	J. W. Rhodes	"	"	"	Sand with some clay	23	37	18.24	83
403	Benjamin Fry	Custer	Mason	"	Sandy loam	27	32	17.94	91
246	Albert Vogel	Ludington	"	"	Sand	37		16.99	88
361	Jacob L. Gebhart	Custer	"	"	Sandy loam	28	32⅛	17.69	82
362	John E. Phillips	"	"	"	" "	36	32⅛	13.27	80
450	A. Vogel	Ludington	"			61		16.79	83
274	Benj. Davis	Big Rapids	Mecosta	Kleinwanzlebener	Sandy loam	26	22	16.42	83
345	Henry Schmidt	Crapo	"	"	Sand and gravel	28	13	17.64	90
393	Arnold Ely	Big Rapids	"	"	Sandy loam	27	27	15.29	76
394	D. N. Bromley	" "	"	"	" "	23	5	17.32	88
263	E. E. Shields	Ingalls	Menominee	"	River bottom	32	12	12.43	80
264	Geo. H. Benjamin	"	"	"	Heavy clay	19	10⅛	18.24	84
265	John Swanson	"	"	"	Sandy loam	15	30	16.37	84
266	J. F. Caldwell	Stephenson	"	"	Clay loam	24	23	17.55	85
267	August Anderson	Daggett	"	"	Pine and hard wood	35		18.30	89
268	Ira Carley	Ingalls	"	"	Sandy loam	18	25	16.56	82
286	J. E. Sayre	Midland	Midland	"	Black sandy loam	19	27	18.18	87
448	Hugh McMillan	La Porte	"	"	Clay loam	31	31⅛	17.07	85
173	John Howe	Lake City	Missaukee	White Sugar Beet	" "	27		15.79	84
411	W. P. Souder	Petersburg	Monroe	Kleinwanzlebener	Yellow sand	18	7¼	16.93	86
358	W. A. French		"			31		15.90	82
381	John Dallard	Wyman	Montcalm	Kleinwanzlebener	Light sand	45		15.70	81
433	A. R. Isham	Butternut	"	"	Sandy loam	26	10¾	19.58	86
382	Larse Larson	Holton	Muskegon	"	Sandy	17	21⅛	18.64	84
386	A. J. Minzey	"	"	"	Light, sandy	32	43 ?	14.57	83
125	H. Paulman	Ravenna	"	"	Sandy loam	18	16	15 64	88
127	Wm. Wendall	Muskegon	"	"	Gray sand	29	32	15.79	89
207	B. F. Aldrich	Whitehall	"			26		13.44	78
365	C. H. Proctor	Holton	"	Kleinwanzlebener	Black sand	25	55 ?	17.58	86
385	Fred Bluhm	Muskegon	"	"	Sandy loam	28	18½	17.75	87
447	Geo. N. Williams	"	"	"	" "	24	32⅛	18.83	88
354	T. B. Crocker	Twin Lake	"	"	" "	25	22⅛	13 21	76
252	W. E. Fulkerson	White Cloud	Newaygo	Vilmorin Imperial	Gravelly loam	30	16	13.38	80
277	Otis Williams	Sun	"	Kleinwanzlebener	Sand	30	10¼	18.32	85
299	Geo. E. Hilton	Fremont	"	"	Clay	21		17.32	82
300	Geo. Harwood	"	"	"	Sandy loam	58	10⅛	10.33	74
301	Henry Rozema	"	"	"	" "	28	18	15.13	80
312	J. Castle	Fremont	"	"	Black loam	23	13	11.01	70
351	Dr. Derby	White Cloud	"	Vilmorin Improved	Sandy	13		12.60	72

Results of cultivation of sugar beets in Michigan in 1897, with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	County.	Variety of sugar beets.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
356	Henry Becker	Hesperia	Newaygo	Kleinwanzlebener	Clay loam	21	22	15.40	80
465	John Fairbrothers	White Cloud	"	"	Sandy loam	28	21	16.99	85
464	Alton Fairbrothers	" "	"	"	Sandy soil	29	17	21.61	80
466	John O. Cook	" "	"	"	New ground	32	17	20.32	89
452	J. Castle	Fremont	"	"	Sandy loam	17		16 56	82
453	Geo. Harwood	"	"	"	Light sand	30		20.49	88
296	L. R. Hunter	South Lyon	Oakland	"	Sandy loam	23	15	17.18	88
311	Joseph L. Tuttle	Walled Lake	"	"	" "	27		9.47	81
289	Asar Brown	Pontiac	"	"	" "	20	10¾	17.18	84
378	D. M. Wood	N. Farmington	"	"	" "	30	14	18.75	88
3[illegible]7	Wm. Evans	Holly	"	"	Gravelly loam	30		14.10	75
34[illegible]	Frank Cuthbert	"	"	"	Clay loam	16	13½	12.33	74
270	J. Shannon	Wixom	"	"	" "	23	?	18.00	89
469	John Smith	Hart	Oceana	"French White"	Sandy loam	21	?	13.99	* 81
470	V. Simons	"	"	Silesian	Sandy	40		8.27	* 61
471	M. Melbrick	"	"	"	Sandy loam	32	?	7.69	* 54
472	N. L. Bird	Benona	"	Kleinwanzlebener	" "	15	?	18.07	* 84
473	S. W. Burdick	Hart	"	French White	Sandy	26	?	15.40	* 77
241	W. W. Gilmore	Shelby	"	" "	Sandy loom	35	13	11.22	78
242	" "	"	"	Vilmorin	" "	28	13	15.90	86
243	" "	"	"	Kleinwanzlebener	" "	31	13	18.49	88
308	H. Vanderwort	New Era	"			14		16.31	90
352	Chas. B. Davidson	Shelby	"	Kleinwanzlebener	Black sandy loam	19	14	19.25	88
462	G. M. Chamberlain	"	"		Sandy loam	28		18 06	88
454	J. Corgan, No. 1	Ontonagon	Ontonagon	Vilmorin	Sandy	50		13.74	75
455	" " " 2	"	"	"	Clay loam	54		14.68	76
456	" " " 3	"	"	"	Sandy loam	80		15.13	78
457	" " " 4	"	"	"	" "	34		17.07	87
347	Nelson Crysler	Reed City	Osceola	Kleinwanzlebener	" "	30	17½	19 00	89
405	Peter Peterson	LeRoy	"	"	" "	25	32	14.11	82
340	Ray Laughlin	Tustin	"	"	Sandy	22	10	17.07	81
250	W. H. Leslie	Vanderbilt	Otsego	"	Sandy loam	14	11½	18.00	90
291	A. A. Pompe	Hudsonville	Ottawa			31		15.64	77
310	C. C. Lillie	Coopersville	"	Kleinwanzlebener	Sandy loam	29	48	14.51	83
316	I. Wabeke	New Holland	"	"	Black loam	28		14.32	80
331	Doune Regnems	Holland	"	"	Sandy	31	43	16.02	83
360	L. DeWeert	"	"	"	Black sand	30	41	13 99	77
333	Mrs. T. C. Parsons	Coopersville	"	"	Sand and muck	26	18	14.10	71

367	M. Brand, Sr.	Vriesland	"	"	Dark clay	26	13	19.44	85
380	Wm. DeHoop	"	"	"	Black sand loam	26		15.40	81
406	O. B. Ryder	Agnew	"	"	Sand and gravel	28	26	18.32	89
408	W. B. Chittenden	Spring Lake	"	"	Black loam	28		19.93	90
412	Jas. L. Fairbanks	Holland	"	"	Clay loam	19	58	18 00	84
124	Geo. W. Densmore	Hudsonville	"	"	Sand and clay loam	28	29½	14.42	82
459	J. H. Krommendyk	Zeeland	"			15		17.69	86
163	J. Caulkett	North Street.	St. Clair	Vilmorin		30		16.31	80
160	David Atkins	Atkins	"	Kleinwanzlebener	Sand and gravel	39	25	18.58	83
170	" "	"	"	Vilmorin	" " "	36	25	20.24	92
161	Geo. Dobson	Lakeport	"	Kleinwanzlebener	Sandy loam	19	19	17.82	89
162	H. Broluskee	Ruby	"	"	Clay loam	37		16.42	83
164	Thos. Russell	Wadhams	"	Vilmorin	" "	25	22	18.42	86
166	J. Caulkett	Lockport	"	Kleinwanzlebener	Sandy loam	39	12	17.43	87
169	Stephen Lambkin	Avoca	"	Vilmorin	" "	31	19½	13.19	80
234	Martha J. Goodwent	Emmet	"			17		21.22	80
427	David McConchie	Ruby	"	Vilmorin	Sandy loam	28	26	18.43	86
429	D. Beard	"	"	"	" "	13	38 ?	19 88	85
430	W. Harrison	Capac	"	Kleinwanzlebener	" "	25	10¼	18.00	88
431	John Cole	Lakeport	"	Vilmorin	" "	21	9½	18.58	83
434	Henry Keil	"	"	Kleinwanzlebener	Clay loam	27	54 ?	20.92	83
137	Albion Howe	Riley's Centre	"	Vilmorin	" "	24	13½	21.29	83
435	E. R. Perry, Sr.	Capac	"	"	Black sandy loam	20	12	14.62	77
438	Thos. Wilkes	Gardendale	"	Kleinwanzlebener	Clay loam	27	20	21.40	89
424	Alex. Atkins	Wadhams	"	"	Sand and clay	22	13¾	20.13	86
116	Chas. Merritt	North Street	"			28		18.58	90
119	Adam Stein	Wadhams	"			13		16.02	81
121	Radike Bros.	St. Clair	"	Kleinwanzlebener	Clay loam	24	7½	16.54	83
	Joseph Kelfgen	Wales	"	Vilmorin	Sandy loam	19	24	15.17	75
	Albert Balfour	St. Clair	"	Kleinwanzlebener	Sandy	30	6	14.91	77
	F. A. Collins	Mt. Salem	"	Vilmorin		11		11.98	73
	W. Darling	Wales	"	"	Clay loam	14	24	16.45	81
	Richard Kilbourn	Elliott	"	"	Clay	10	14½	18 81	81
	Michael Myron	Blaine	"	Kleinwanzlebener	Clay loam	28	14	16.04	83
167	Thos. Russell	Wadhams	"	Vilmorin		21		16.25	80
425	John Cole	Lakeport	"	Kleinwanzlebener		26		19.90	88
436	Alex. Atkins	Wadhams	"	"		24		15 75	81
165	John Natus	Hasen's Island	"	White Perfection	Black muck & sand	31	5	14.10	75
449	Mrs N. Ketchum	Factoryville	St. Joseph	Kleinwanzlebener	Heavy clay	24	14	12.16	76
168	Dennis Cremean	Applegate	Sanilac	Vilmorin	Sandy	31	19	18.45	85
187	Wm. Grimes	Speaker	"	Kleinwanzlebener	Clay loam	21	22	17.08	89
275	Henry Wisner	Chevington	"	"Congressional"	Clay	21	10	19.81	88
428	W. J. Martin	Croswell	"	Vilmorin	Loam	25	20	19.00	85
392	F. S. Stecker	"	"	Kleinwanzlebener	Clay, sand and loam	31	16	18.07	89
118	A. Shoemaker	Brown City	"	Vilmorin	Clay loam	30	21½	16.56	84

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* Not considered in average on account of dried condition of the beets.

Results of cultivation of sugar beets in Michigan in 1897, with reports from experimenters and results of analysis of the sugar beets.

Lab. No.	Name.	Locality.	County.	Variety of sugar beets.	Kind of soil.	Average weight of the beets in ounces.	Tons per acre.	Per cent. of sugar.	Purity.
120	David J. Decker	Croswell	Sanilac			26		19.33	81
329	Alex. Mann	Berkshire	"	Kleinwanzlebener	Clay with muck	52	47 ?	17.47	80
418	T. A. Hillman	Chevington	"		Clay loam	19		16.88	83
420	W. J. Martin	Croswell	"			19		20.98	89
....	Andrew Brown	Brown City	"	Vilmorin	Sandy clay	20	24	16.04	83
....	A. B. Cook	Owosso	Shiawassee	Kleinwanzlebener	Clay loam	30	10	18.89	89
390	T. D. Dewey	"	"	"	Black sandy loam	28	11	14.88	81
315	Chas. Goodwin	"	"	"	Gravel loam	21	22⅛	20.07	85
328	F. D. Bentley	"	"	"	Sandy loam	58	11¼	13.74	77
416	Robert Wood	Mayville	Tuscola	"	Clay loam	18	23⅛	18.94	89
227	T. Trowbridge	Decatur	Van Buren	"	Sandy loam	13	21¼	13.19	80
257	Wm. H. Newell	Lawton	" "	"	" "	15	89 ?	15.79	84
321	Chas. H. Bolinger	Almena	" "	"	Sandy	16	21½	11.90	73
355	A. C. Glidden	Paw Paw	" "	"	Gravelly loam	20	9¼	14.42	82
244	Geo. W. English	Chelsea	Washtenaw	"	Clay loam	17	8	18.83	90
305	Martin Brining	Whittaker	"			26		12.03	73
387	J. Evarts Smith	Ypsilanti	"		Sandy loam	28	33	15.29	88
474	W. W. Blake	Ann Arbor	"	Kleinwanzlebener	" "	21		18.24	84
211	E. A. Bodden, No. 2	Leesville	Wayne	"	Clay	45	28	18.38	90
212	" " " 1	"	"	"	Gravelly loam	28	26	17.18	84
294	G. M. McCarty	Wayne	"	"	Black loam	24	20⅛	15.02	83
295	Geo. A. Welle	Flat Rock	"			27		17.49	83
344	Edward Bodden	Leesville	"			26		17.07	89
346	Jas. R. Clark	Belleville	"	Kleinwanzlebener	Sandy loam	32	27	17.55	86
417	S. H. Wilbur, Jr.	Wayne	"	"	" "	21	44 ?	21.46	90
370	T. E. Haddon	Redford	"	Pink colored beets		26		8.44	76
377	" "	"	"	Vilmorin		27		12.49	77
348	B. D. Davidson	Mesick	Wexford	Kleinwanzlebener	Sandy loam	31	43 ?	14.22	78
349	J. F. Henderson	Manton	"			25		17.13	87
439	John Harvey	Sherman	"	"Congressional"	Gravelly loam	80	23	14.74	79
440	Fred Hector	Cadillac	"	From Dep't of Agriculture	Sandy loam	24	43 ?	9.51	65
441	John Leeson	"	"	" " " "		37	?	16.62	80
442	John Cassity	Meanwataka	"	" " " "	Sandy loam	31	32½ ?	15.19	83
443	H. B. Sturtevant	Sherman	"			33		13.99	77
389	L. McClesh	Mesick	"	Lanc's Imperial	Light sandy	21	43 ?	16.44	84
353	T. H. Callis	Manton	"	From Dep't of Agriculture	Sandy	28	14	13.47	80

RESULTS BY COUNTIES.

In order to present the results in the different sections of the State, Table II is inserted, giving the number of samples sent to the Station from each county, the average per cent of sugar and coefficient of purity, of all samples sent, and a corrected table in which the samples grown on the wrong kind of soil, or with poor seed, are omitted. Seed was distributed in sixty-eight counties, and from the table below it will be seen that samples have been received from sixty-four of them. The average per cent of sugar in the beets of the whole State, when grown on the proper kind of soil and from the right kind of seed, is 16.40, and the coefficient of purity is 84. This coefficient of purity signifies that of the whole amount of materials in solution in the sap of the beet, 84 per cent is sugar and only 16 per cent is gummy, saline or non-saccharine matter. An average of 16.40 per cent of sugar for the whole State, far exceeding the best districts in France and Germany, is both surprising and gratifying.

TABLE II.—*Results by counties.*

Counties.	Total number of samples.	Per cent. of sugar in them.	Coefficient of purity.	Samples rejected for bad soil or seed.	No. of samples on right soil and proper seed.	Per cent of sugar in such samples.	Coefficient of purity.
Alger	1	14.22	80	0	1	14.22	80
Allegan	3	15.67	86	0	8	15.67	86
Alpena	2	15.01	80	0	2	15.01	80
Antrim	2	15.97	82	0	2	15.97	82
Arenac	8	16.77	85	0	8	16.77	85
Baraga	1	14.10	76	0	1	14.10	76
Barry	4	14.90	81	0	4	14.90	81
Bay	10	15.53	84	1	9	16.00	84
Berrien	3	17.83	87	0	3	17.83	87
Branch	3	16.62	84	0	3	16.62	84
Calhoun	6	15.82	84	0	6	15.82	84
Cass	2	15.44	82	0	2	15.44	82
Charlevoix	7	17.58	87	0	7	17.58	87
Clare	1	16.80	84	0	1	16.80	84
Clinton	4	15.89	84	1	3	16.05	86
Crawford	1	15.25	81	0	1	15.85	81
Eaton	5	17.50	83	0	5	17.50	88
Emmet	1	15.02	82	0	1	15.02	82
Genesee	6	14.75	82	1	5	16.14	84
Grand Traverse	7	15.75	82	2	5	15.91	83
Gratiot	6	16.09	83	0	6	16.09	83
Hillsdale	2	16.71	84	0	2	16.71	84
Huron	6	17.47	85	0	6	17.47	85
Ingham	36	16.43	87	1	35	16.53	87
Ionia	4	16.36	82	0	4	16.36	82
Iosco	6	13.18	77	1	5	14.22	79
Iron	1	18.18	80	0	1	18.18	80
Isabella	4	14.09	78	1	3	16.41	82
Jackson	7	9.74	74	5	2	18.16	86
Klamazoo	16	15.45	82	2	14	15.87	82

TABLE II.—CONCLUDED.—*Results by counties.*

Counties.	Total number of samples.	Per cent of sugar in them.	Coefficient of purity.	Samples rejected for bad soil or seed.	No. of samples on right soil and proper seed.	Per cent of sugar in such samples.	Coefficient of purity.
Kalkaska	2	16.91	83	0	2	16.91	83
Kent	16	15.55	83	2	14	15.85	84
Lapeer	2	17.71	84	0	2	17.71	84
Leelanaw	3	18.77	89	0	3	18.77	89
Lenawee	5	15.96	85	0	5	15.96	85
Livingston	2	14.34	80	0	2	14.34	80
Mackinac	1	16.22	85	0	1	16.22	85
Macomb	11	16.11	82	2	9	16.91	83
Manistee	6	17.09	84	0	6	17.09	84
Mason	5	16.54	85	0	5	16.54	85
Mecosta	4	16.67	84	0	4	16.67	84
Menominee	6	16.58	84	0	6	16.58	84
Midland	2	17.62	86	0	2	17.62	86
Missaukee	1	15.79	84	0	1	15.79	84
Monroe	2	16.41	84	0	2	16.41	84
Montcalm	2	17.64	83	0	2	17.64	83
Muskegon	9	16.03	85	0	9	16.03	85
Newaygo	13	16.11	81	1	12	16.54	81
Oakland	7	15.29	83	1	6	16.26	83
Oceana	* 11	16.54	86	0	11	16.54	86
Ontonagon	4	15.15	79	0	4	15.15	75
Osceola	3	16.55	85	0	3	16.55	89
Otsego	1	18.00	90	0	1	18.00	90
Ottawa	15	16.47	83	0	15	16.47	83
Saginaw	127	15.99	84	4	123	16.13	84
St. Clair	31	17.53	83	1	30	17.64	83
St. Joseph	1	12.16	76	0	1	12.16	76
Sanilac	11	18.15	86	0	11	18.15	86
Shiawassee	4	16.89	83	0	4	16.89	83
Tuscola	1	18.94	89	0	1	18.94	89
Van Buren	4	13.82	80	0	4	13.82	80
Washtenaw	4	16.10	84	0	4	16.10	84
Wayne	9	16.12	34	1	8	17.08	85
Wexford	9	14.59	79	1	8	15.25	81
Sixty-four counties	493	------	-------	------	465	--------	-----
Average	------	16.08	83	------	------	16.40	84

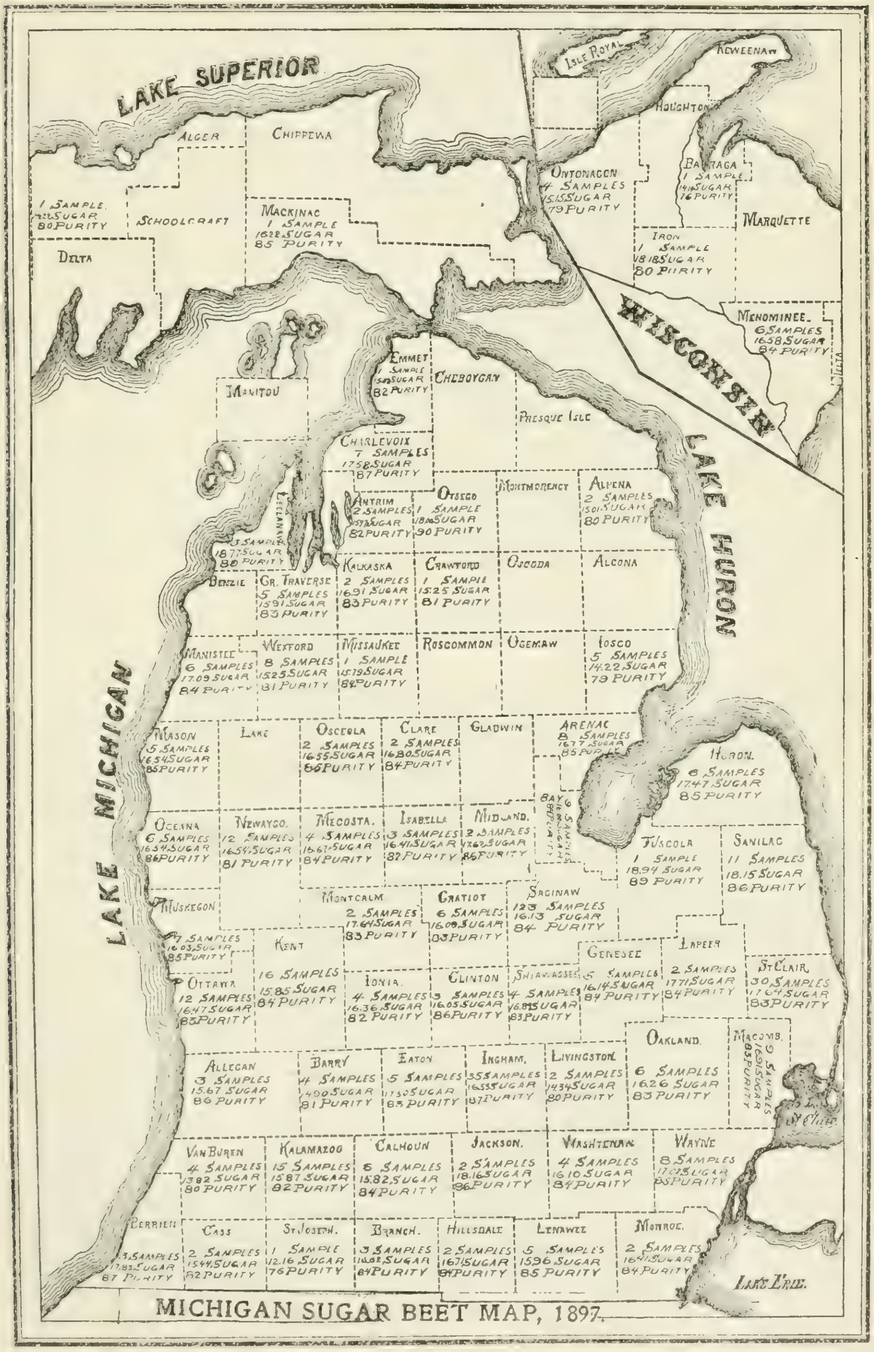
* Five samples from Oceana county are not included in results of analysis because they were dried and damaged by keeping.

MICHIGAN SUGAR BEET MAP, 1897.

To present the various facts embraced in the preceding tables relating to the growth of sugar beets in this State in 1897 in such shape that they can be seen at a glance, a sugar beet map is here inserted which shows the leading facts in regard to the experiments on this crop in our State for the year 1897.

This map shows by counties the number of samples of beets sent to the Experiment Station, the average content of sugar, and the coefficient of purity. The map speaks for itself.

MICHIGAN SUGAR BEET MAP, 1897.


LAKE SUPERIOR
ISLE ROYAL
KEWEENAW
HOUGHTON
ALGER
CHIPPEWA
ONTONAGON 4 SAMPLES 15.15 SUGAR 79 PURITY
BARAGA 1 SAMPLE SUGAR 76 PURITY
1 SAMPLE SUGAR 80 PURITY
SCHOOLCRAFT
MACKINAC 1 SAMPLE 16.22 SUGAR 85 PURITY
MARQUETTE
IRON 1 SAMPLE 18.18 SUGAR 80 PURITY
DELTA
WISCONSIN
MENOMINEE 6 SAMPLES 16.58 SUGAR 84 PURITY
DELTA
EMMET 1 SAMPLE SUGAR 82 PURITY
CHEBOYGAN
MANITOU
PRESQUE ISLE
CHARLEVOIX 7 SAMPLES 17.58 SUGAR 87 PURITY
LAKE HURON
ANTRIM 2 SAMPLES SUGAR 82 PURITY
OTSEGO 1 SAMPLE SUGAR 90 PURITY
MONTMORENCY
ALPENA 2 SAMPLES 15.01 SUGAR 80 PURITY
LEELANAW 3 SAMPLES 18.77 SUGAR 80 PURITY
BENZIE
GR. TRAVERSE 5 SAMPLES 15.91 SUGAR 83 PURITY
KALKASKA 2 SAMPLES 16.91 SUGAR 83 PURITY
CRAWFORD 1 SAMPLE 15.25 SUGAR 81 PURITY
OSCODA
ALCONA
MANISTEE 6 SAMPLES 17.09 SUGAR 84 PURITY
WEXFORD 8 SAMPLES 15.25 SUGAR 81 PURITY
MISSAUKEE 1 SAMPLE 15.19 SUGAR 84 PURITY
ROSCOMMON
OGEMAW
IOSCO 5 SAMPLES 14.22 SUGAR 79 PURITY
LAKE MICHIGAN
MASON 5 SAMPLES 16.54 SUGAR 85 PURITY
LAKE
OSCEOLA 2 SAMPLES 16.55 SUGAR 86 PURITY
CLARE 2 SAMPLES 16.80 SUGAR 84 PURITY
GLADWIN
ARENAC 8 SAMPLES 16.77 SUGAR 85 PURITY
HURON 6 SAMPLES 17.47 SUGAR 85 PURITY
BAY 6 SAMPLES SUGAR PURITY
OCEANA 6 SAMPLES 16.54 SUGAR 86 PURITY
NEWAYGO 12 SAMPLES 16.54 SUGAR 81 PURITY
MECOSTA 4 SAMPLES 16.67 SUGAR 84 PURITY
ISABELLA 3 SAMPLES 16.41 SUGAR 87 PURITY
MIDLAND 2 SAMPLES 17.62 SUGAR 85 PURITY
TUSCOLA 1 SAMPLE 18.94 SUGAR 89 PURITY
SANILAC 11 SAMPLES 18.15 SUGAR 86 PURITY
MUSKEGON 7 SAMPLES 16.03 SUGAR 85 PURITY
MONTCALM 2 SAMPLES 17.64 SUGAR 83 PURITY
GRATIOT 6 SAMPLES 16.09 SUGAR 83 PURITY
SAGINAW 123 SAMPLES 16.13 SUGAR 84 PURITY
KENT 16 SAMPLES 15.85 SUGAR 84 PURITY
GENESEE 5 SAMPLES 16.14 SUGAR 84 PURITY
LAPEER 2 SAMPLES 17.71 SUGAR 84 PURITY
ST CLAIR 30 SAMPLES 17.64 SUGAR 83 PURITY
OTTAWA 12 SAMPLES 16.47 SUGAR 83 PURITY
IONIA 4 SAMPLES 16.36 SUGAR 82 PURITY
CLINTON 3 SAMPLES 16.05 SUGAR 86 PURITY
SHIAWASSEE 4 SAMPLES 16.85 SUGAR 83 PURITY
OAKLAND 6 SAMPLES 16.26 SUGAR 83 PURITY
MACOMB 9 SAMPLES 16.91 SUGAR 83 PURITY
ALLEGAN 3 SAMPLES 15.67 SUGAR 86 PURITY
BARRY 4 SAMPLES 14.90 SUGAR 81 PURITY
EATON 5 SAMPLES 17.05 SUGAR 83 PURITY
INGHAM 35 SAMPLES 16.55 SUGAR 87 PURITY
LIVINGSTON 2 SAMPLES 14.34 SUGAR 80 PURITY
ST CLAIR
VAN BUREN 4 SAMPLES 13.82 SUGAR 80 PURITY
KALAMAZOO 15 SAMPLES 15.87 SUGAR 82 PURITY
CALHOUN 6 SAMPLES 15.82 SUGAR 84 PURITY
JACKSON 2 SAMPLES 18.16 SUGAR 86 PURITY
WASHTENAW 4 SAMPLES 16.10 SUGAR 84 PURITY
WAYNE 8 SAMPLES SUGAR 85 PURITY
BERRIEN 3 SAMPLES 17.83 SUGAR 87 PURITY
CASS 2 SAMPLES 15.44 SUGAR 82 PURITY
ST JOSEPH 1 SAMPLE 12.16 SUGAR 76 PURITY
BRANCH 3 SAMPLES 16.82 SUGAR 84 PURITY
HILLSDALE 2 SAMPLES 16.71 SUGAR 84 PURITY
LENAWEE 5 SAMPLES 15.96 SUGAR 85 PURITY
MONROE 2 SAMPLES 16.41 SUGAR 84 PURITY
LAKE ERIE
MICHIGAN SUGAR BEET MAP, 1897.

TONS OF BEETS PER ACRE.

An effort was made to find the yield of sugar beets in different localities in the State by sending out blanks giving directions to measure off sixty-six feet in the row where these rows were eighteen inches apart, to count the number of beets, and to give the weight in pounds of the beets after removing the necks and tops. The estimate of the pounds per acre was to be made by multiplying the weight of the beets in this sixty-six feet of row by 435.6; by dividing this product by two thousand we would find the number of tons of beet roots to the acre. Many persons seem to have reported the number of pounds gathered from the whole plot, instead of the pounds from a row of sixty-six feet. The calculation shows some astonishing results in tons per acre, ranging from five to three hundred and forty-three tons. Requests for revised estimates have been in most cases without success. The report of large yields above twenty tons to the acre must be viewed with suspicion and the estimates considered very doubtful. In a large number of cases, however, great care has been employed to give accurate results, and for this care the people of the State are grateful.

From the results of careful measurements at the Station farm, and from the results of many careful and accurate experiments elsewhere, it would not be safe to place the range of yields per acre for 1897 higher than from twelve to eighteen tons.

IS THE SUGAR BEET AN EXHAUSTING CROP?

Before the farmer will make a radical change in his crop rotation, by bringing in the sugar beet, he will naturally ask what the influence of the new crop on the fertility of his farm will be. When the entire crop is removed from the field it is unquestionably exhausting, carrying off a large amount of fertilizing material, especially potash and phosphates. The leaves and crown contain a relatively larger amount of fertilizing materials than does the same weight of roots. To prevent unnecessary depletion, it is said that in certain districts the manufacturers require the farmers not to remove the leaves from the field, unless they are used as fodder and their fertilizing ingredients thus returned to the soil as manure. If this is done, and the beet pulp or residue after extracting the sugar is used as food for cattle, and in this way returned to the soil, there is absolutely no loss of fertilizing materials, and no farm crop so little exhausts the soil as sugar beets. Where there is nothing sold off the farm but the sugar, the crop removes no fertilizing material whatever. While sugar is valuable as food, it contains no element of fertility, no potash, lime, phosphate, nitrogen or other manurial material. It consists of carbon, oxygen and hydrogen, the elements taken up by the plant from the air, directly or indirectly; in selling the sugar, therefore, the farmer is selling wind and water only. In France the raising of sugar beets for the factory, where everything but the sugar was kept on the farm, has resulted in increasing the fertility of the soil, and has promoted the agricultural prosperity of the district. The beet pulp as it comes from the factory is found to be a most valuable food for dairy and fattening stock.

At Grand Island, Neb., fine herds of fattening steers have been fed nothing but beet pulp and prairie hay and have laid on flesh at a rapid rate. The quality of meat was said to be superior. The pulp retains enough sugar to make it a very palatable food for stock. As a matter of fact, however, the farmers of Nebraska have been rather slow to take advantage of this addition to the ration of their cattle.

R. M. Allen, the general manager of the Standard Cattle Company, of Ames, Nebraska, has been experimenting with feeding pulp to cattle. In the winter of 1892-3 he fed two hundred and seventy-five head of cattle under many difficulties, and in several ways the results were unsatisfactory and incomplete. In a letter received at the Station early in November, Mr. Allen writes: "A number of cattle were fed beet pulp, corn silage and hay alone for four months, making the cheapest ration we ever fed. Other cattle were fed on a hundred pounds of pulp and six pounds of mixed cornmeal and ground oil cake; other cattle on fifty pounds of pulp and ten of meal, all cattle getting hay."

The only things that were decided by the experiment were:

"First, That the cattle would eat as much as a hundred pounds of pulp a day;

"Second, That they eat pulp with evident satisfaction and great relish;

"Third, That they consume very little or no water at all while eating pulp.

"Other points as to which I feel satisfied in my own mind, but which perhaps I cannot clearly demonstrate, are, that the use of pulp will effect a valuable saving of other food, both hay and grain, and that in the feeding of cattle for beef, by the use of pulp we can probably effect an economy of twenty to thirty per cent of the total cost of food. In years of drouth, when food stuffs are very high, the saving will be a very valuable one indeed. Pulp is very bulky and costly to transport, and expensive to handle. These charges, however, cut no figure with farmers delivering beets to a factory, who can as well as not take back a load of pulp to their farm. Pulp can be kept very easily indeed, as it becomes extremely compact and sours or ferments slightly. A large pile can even be left out doors in very cold weather, and while a crust eight or ten inches will freeze on the outside the inside will remain in good condition.

"Some of these cattle, after being fed four months, were sold in Chicago. Spayed heifers dressed out 60 per cent, and steers 62.2 per cent, favorably reported on by Swift & Co.

"Prof. Nicholson of Lincoln, Neb., analyzed some pulp for me with the following results:

"Organic matter, 10.78 per cent.
"Digestible protein, .37 per cent.
"Digestible crude fibre, 1.18 per cent.
"Digestible N. free extract, 3.49 per cent.
"Digestible fat, .06 per cent.
"Nutritive ratio, 1:7.1.

"I made at the same time a small experiment in feeding molasses, for the sole purpose of finding out if cattle would eat it. They quickly got on quite a feed of molasses and it is possible that some time this may become a cattle food in this country.

"All pulp should properly be fed in a barn where it cannot freeze and with other foods. During the earlier part of the feeding period, for instance, for three or four months out of six, it may be fed largely with a comparatively small feed of grain, although hay should always be fed with it. Toward the end of the feeding period the proportion of grain should be gradually increased and that of the pulp diminished for finishing the cattle for market.

"I attach the greatest possible importance in value to the use of beet pulp in beef production, and no doubt it will prove equally valuable in the dairy industry. Its value in feeding animals is one of the reasons why the production of sugar itself may find a firmer and more profitable location where dairy or beef animals are fed than in other sections where there are not so many animals to feed."

A letter from I. R. Alter, President of the Union Stock Yards Co. Grand Island, Neb., includes the following statement of his experience with the pulp: "I fed three hundred, three and four year old western steers in 1891, the first year our factory opened; of course I had no experience in feeding pulp, but I soon found that cattle were very fond of it, I think they will leave any other food known and eat it. As to the fattening quality, of course, when fed alone, it is almost valueless, though I believe stock would winter on it. Mixed with a cut feed of hay or straw or cornstalks, on which corn meal, bran or some other grain food is placed, it makes a ration which fattens very rapidly. By feeding the usual amount of meal, with seventy-five to a hundred pounds of this pulp per day per steer, the fattening period will be shortened at least thirty days, in other words you can get as good results in four months with pulp as you could in five without it. I think steers will eat as much grain food per day or more with the pulp than they will without it. It is a great 'conditioner' and appetizer, and we find the older it is the better the results. It will keep a number of years in the silo or piled up on top of the ground. It will turn black and spoil as far as the air goes through, which is from eight to ten inches. It will reduce in bulk fully one-half and grow as much richer. There are a number of big sheep and cattle feeders here, all of whom use it more or less. If anything, it is better for sheep than cattle."

Our consuls in the sugar producing districts of Europe call special attention to the need of combining the feeding of stock with the growing of sugar beets. While the leaves are good fodder, the pulp in particular should be fed to dairy stock, greatly promoting the production of milk, or to stock fitting for the shambles furnishing beef of the highest quality.

The thorough cultivation required in raising a crop of beets admirably fits the soil for the following crop. In France, no preparation of the soil for a crop of wheat is considered equal to the raising of a crop of beets. Sugar beets are therefore seen to be an enriching crop to the land, fitting admirably into our scheme of rotation, suited to our soil and climate, a cash crop, producing a material in large demand but now imported from abroad.

THE FACTORY.

To secure to the farmer the benefits of this sugar beet industry, a factory is required, to work up the beets and extract the sugar. This is the most serious problem of the whole matter. It involves an outlay of capital that to the farmer seems excessive and useless. The manufacturer, to succeed, must have the best machinery that the world can produce, the most labor saving, the least expensive to operate and the one that will extract the largest amount of sugar of best commercial quality from the beets. He is in competition with the best machinery, and highest skill of the race. No old and discarded apparatus however useful in former years will serve his turn. A first class, up-to-date sugar plant cannot be secured for less than $300,000, add to that $100,000 for buildings and working capital and you have the lowest price for which a successful plant can be established. It is worse than folly to talk about putting up a cheap plant and making sugar in a small way.

In the second place the factory requires a good supply of rich sugar beets. This supply must be certain year after year. It is estimated that a crop of 3,500 acres of beets will be required each year to properly stock a sugar factory.

The other requirements of a factory, plenty of good water (2,000,000 gallons a day), cheap fuel, plenty of limestone in the immediate vicinity of the factory and finally good railroad facilities, will be looked after by the manufacturers themselves.

THE FUTURE OF SUGAR BEET GROWING IN MICHIGAN.

The results secured in growing sugar beets in this State both in 1891 and 1897 show that the climatic and soil conditions for their growth in our State are full of promise. Even the results in counties in the upper peninsula, where promising results would not be expected, are surprising, both in the amount of sugar and the purity of the juice. Large sections of the Lower Peninsula show results far in advance of the best beet sugar districts in France and Germany and equal to the best in our own country. The commonwealth holds out her encouraging hand in the bounty law offering a bonus of one cent a pound on beet sugar made in this State, as shown by act No. 48 of the session laws of 1897, which is here given in full:

[No. 48.]

AN ACT to provide for the encouragement of the manufacture of beet sugar and to provide a compensation therefor and to make an appropriation therefor.

SECTION 1. *The People of the State of Michigan enact*, That there shall be paid out of the State Treasury to any person, firm or corporation engaged in the manufacture in the State of Michigan of sugar from sugar beets grown in the State of Michigan one cent per pound upon each and every pound of sugar so manufactured under the conditions and restrictions hereinafter provided.

SEC 2. No money shall be paid for sugar so manufactured unless such sugar shall have been so manufactured in this State and from beets grown in the State of Michigan, and unless such sugar shall contain at least ninety per cent crystallized sugar, and the manufacturer shall produce good and sufficient receipts and vouchers to show that at least four dollars per ton of twenty hundred pounds has actually been paid for all beets purchased containing twelve per cent of sugar, said twelve per cent being the basis for valuation of the purchase price of four dollars per ton. The quantity and quality of sugar upon which all of said bounty is claimed shall be determined by the Commissioner of the State Land Office, with whom all claimants shall from time to time file verified statements showing the quantity and quality of sugar so manufactured by them, the price paid the producer for the beets actually produced in this State, upon which said bounty is claimed.

SEC. 3. The persons, firms or corporations so intending to engage in the manufacture of beet sugar in this State shall, before commencing the same, file a statement with the Commissioner of the State Land Office setting forth their proposed undertaking, the capacity of their manufactory, the number of tons of beets they intend to manufacture per annum, and request said Commissioner of the State Land Office to appoint a suitable weighman and inspector as hereinafter provided.

SEC. 4. It shall be the duty of the Commissioner of the State Land Office to appoint a resident weighman and inspector and such assistants as may be necessary in each town where it shall appear to him from the application of the persons, firms or corporations so engaged or intending to engage in the manufacture of beet sugar, that such weighman and inspector is needed, and in all cases where the output of persons, firms and corporations engaged in the manufacture of beet sugar in this State shall aggregate or exceed two thousand pounds per day, and such weighman and inspector shall weigh all beets received by such persons, firms or corporations engaged in the manufacture of beet sugar, and keep an accurate account of the same, with each and every purchaser of sugar beets and make such examination and test as to the quantity and quality of the sugar so manufactured as he may deem proper in arriving at the standard of sugar in each town, so manufactured by such persons, firms or corporations. The sugar thus manufactured shall, under the direction of said weighman and inspector, be placed in original packages, which shall be examined, weighed and branded by him by a suitable brand showing the quantity and quality contained in each of said packages of which an accurate account shall be by him filed in the office of the Commissioner of the State Land Office.

SEC. 5. The compensation and fees for such services, above provided for, to be performed by said weighman and inspector and assistants, shall not exceed one-eighth of one cent per pound for the beet sugar so examined, weighed and branded by him, nor shall they receive to exceed the sum of three dollars per day for any one day's service actually performed as such weighman and inspector or assistant. He shall give a bond with good and sufficient sureties in the sum of not less than two thousand dollars to the State of Michigan, contingent upon the faithful performance of his duties, said bond to be approved by the Secretary of State, and he shall also take, subscribe and file in the office of the Secretary of State the constitutional oath of office. The said fees of compensation together with the cost of said brand and all analyses that the said weighman and inspector shall be required to make shall be borne and paid by the persons, firm or corporation claimant of said money; the said weighman and inspector shall perform all duties pertaining to his position in an impartial manner, and shall furnish and file with the Commissioner of the State Land Office, also with the manufacturer of said beet sugar, a monthly statement in duplicate of all sugar so manufactured by said person, firm or corporation. The said weighman and inspector shall, upon receipt of beets at such manufactory, select such samples of beets as he deems fair and equitable, and shall keep an accurate record of the gross weight of said samples, and shall estimate the per cent of said gross weight to be deducted therefrom as a reasonable and fair allowance for dirt and dockage, and he shall also test, or cause to be tested, said samples to ascertain the true per cent of sugar they contain, and make a record of the same. All beets from which samples have been taken shall be promptly weighed and an accurate record of the gross weights of the same shall be kept, also of the number of pounds to be deducted for dirt and dockage as fixed by the per cent of dirt and dockage of the samples, and also of the pounds net weight so obtained, and said net weight and the per cent of sugar as determined by the test of the samples shall be the basis of settlement between the buyer and seller, and in order to obtain the bounty provided by this act the buyer must pay at least four dollars per ton for beets containing twelve per cent of sugar, and a sum proportionate to that amount shall be paid for beets containing a greater or less per cent of sugar.

SEC. 6. When any claim arising under this act is filed, verified and approved by the Commissioner of the State Land Office as hereinafter provided, he shall verify the same to the Auditor General of the State, who shall draw a warrant upon the State Treasurer for the amount thereof payable to the person, firm or corporation to whom said sum or sums are due.

SEC. 7. That the sum of ten thousand dollars be and the same is hereby appropriated from the general fund in the State Treasury, not otherwise appropriated, to be known as the beet sugar fund, and to be expended under the direction of the Commissioner of the State Land Office as herein provided and the money for payment under this act shall be drawn from the State Treasury on the requisition of the Commissioner of the State Land Office, which shall be presented to the Auditor General, who shall draw his warrant on the State Treasurer therefor, and the Auditor General shall incorporate in the State tax for the year eighteen hundred and ninety-seven the sum of five thousand dollars, and for the year eighteen hundred and ninety-eight a like sum of five thousand dollars to be assessed, levied and collected as other State taxes are assessed, levied and collected, which sum when collected shall be placed to the credit of the general fund to reimburse it for the sum herein appropriated: *Provided*, That if the amount of bounty shall exceed the amount of ten thousand dollars for the years eighteen hundred and ninety-seven and eighteen hundred and ninety-eight; that the deficit be paid from the general fund not otherwise appropriated

SEC. 8. Every person, firm or corporation that shall erect and have in operation in this State a factory for the manufacture of sugar from beets with a capacity of two thousand pounds of sugar or upwards per day while this act is in force shall be entitled to receive from the State the sum of one cent per pound for all sugar manufactured from beets at such factory for a period of at least seven years from the taking effect of this act.

Approved March 26, 1897.

CONCLUSIONS.

The results of the experiments carried on in 1897 are very encouraging in many respects.

1st. The labor cost of growing an acre of beets under adverse conditions, reckoning the cost as twenty-five cents an hour for man and team, twelve and one-half cents an hour for a man, and eight cents for a boy, was $29.40.

2nd. The average yield per acre on the College farm was fourteen tons, three hundred and twenty-eight pounds.

3rd. The soil and climate of a large part of Michigan are well adapted to raising sugar beets for manufacturing purposes.

RASPBERRIES, BLACKBERRIES AND GRAPES.

BY L R TAFT AND H. P. GLADDEN.

Bulletin 151.—Horticultural Department.

RASPBERRIES.

A few varieties of raspberry were badly killed back by the winter, but most sorts were in good condition for fruiting in the spring. Considerable anthracnose was present, but spraying with Bordeaux mixture kept the disease in check until after the berries were picked, when the old canes were removed and burned. The excessive rainfall on a soil where the quicksand closely approaches the surface, seriously injured many sorts.

NOTES ON VARIETIES.

Beckwith.—Received from M. H. Beckwith, Newark, Del. The growth of cane and foliage is somewhat like Columbian, though the canes are lighter in color, with more numerous but shorter spines; the leaves are larger, coarser in texture and a darker green. Berries are large, purple, scarcely so dark as Columbian, but they are firmer and of better quality. This is the first year of fruiting and the growth was too small to judge of productiveness.

Black Diamond.—Received from C. M. Stewart & Co., Newark, N. Y. Appears to be of strong, healthy growth. The berries are large, jet black and shining, rather long conical in form and of high quality. A few fruits ripened with *Kansas,* but the main crop is a few days later. It may prove a valuable sort to come between *Kansas* and *Gregg.*

Conrath.—The cane growth was not so strong and healthy as is usual with this variety, but a fair crop of good sized berries was borne. We regard this as a valuable medium early market berry.

Columbian.—This variety suffered badly from anthracnose, and the berries were much smaller in size and produced in less quantity than in former seasons. One of the best of the purple cap class.

Farnsworth.—The canes were of good growth, stood the winter well and were quite free from disease. A very desirable sort for home use or market.

Gault.—This sort has never been of strong growth and the canes have borne but little fruit. It has never given promise of much value here.

BLACK AND HYBRID RASPBERRIES.

ABBREVIATIONS.

Size.	Form.	Color.	
s, small.	r, round.	b, black.	g, glossy.
m, medium.	c, conical.	p, purple.	l, light.
l, large.	o, ovate.	o, orange.	pu, pubescent.

Variety.	Vigor.	Date bloom.	Date first ripe fruits.	Date last fruits.	Productiveness. (1-10)	Size.	Form.	Color.	Quality.
Beckwith	9	June 17	July 19	July 31	8.8	l	r c	p	9.5
Black Diamond	9.5	" 14	" 12	" 29	8.5	l	r c	b	8.8
Caroline	9.5	" 15	" 12	" 27	8	m	r	l o	8
Conrath	8	" 12	" 12	" 28	8.5	l	r	b	8
Columbian	9	" 18	" 16	" 31	8.8	m	r o	p	8.5
Ebon Beauty	4	" 14	" 13	" 27	4	m	r c	b	7
Eureka	8	" 14	" 11	" 27	6.5	l	r c	b	7
Farnsworth	7.5	" 14	" 12	" 30	8.5	l	r	b	8.5
Gault	4	" 14	" 12	" 28	5	m	r c	b	8.5
Green	6	" 12	" 12	" 28	6.5	l	r	o pu	9
Gregg	5	" 14	" 14	" 30	8	l	r	b pu	7
Johnston	8.5	" 11	" 11	" 28	7.5	m	r	b	6
Kansas	9	" 12	" 13	" 29	9	l	r	g b	8.5
Lovett	4	" 12	" 11	" 28	6	m	r	b	8
May King	3	" 12	" 12	" 27	2	s	r c	b	7.5
Mill's No. 15	9.5	" 12	" 12	" 31	9	l	r c	b	8.5
Nemaha	4.5	" 14	" 16	" 31	8.8	l	r	b pu	7
Ohio	6	" 10	" 11	" 27	8	l	r	b	6
Older	8.5	" 12	" 12	" 30	8	l	r	b	9
Palmer	8.5	" 11	" 8	" 27	8.5	m	r	b	8.5
Progress	4	" 12	" 11	" 28	5	s	r	b	8.5
Redfield	8	" 17	" 12	" 29	8.5	m	r c	p	8
Shaffer	8	" 20	" 15	" 31	8.8	l	r s	p	8.5
Wonder	5	" 14	" 14	" 28	2	m	r c	b	8.8

Green.—Bush was of weak growth and but a small crop of fruit was borne. The berries are of good size, rather soft but of good quality. The variety was sent out as Green's New Raspberry, an objectionable name.

Gregg.—Perhaps the best late market sort. The canes are often badly injured by the winter and the variety should only be planted on a high, well-drained location.

Kansas.—This variety has been grown for several seasons and has uniformly given good results. The bush is of strong, healthy growth, and the canes are quite hardy. The berries are large, of fine appearance, though not of high quality.

Mills No. 15.—The canes are of good growth and stand the winter well. The berries are large, jet black in color, not so dry or firm as Gregg, but better in quality. In season a little earlier than Gregg. Appears to be of considerable promise.

Ohio.—While this variety usually produces a large crop, the berries are very poor in quality. It is the leading sort for evaporating purposes.

Older.—The berries are large and of high quality, but soft. As the variety is productive it is valuable for home use.

Palmer.—One of the best early market sorts.

Redfield.—Received from J. Wragg & Son, Waukee, Iowa. Canes of very strong growth, dark purple color, covered with white bloom; spines few, short. Fruits of purple cap class, smaller in size than the Shaffer and more acid in flavor. This was the first year of fruiting.

Shaffer.—This variety is quite susceptible to attacks of anthracnose. One of the best varities for canning and home use.

Ebon Beauty, *Eureka*, *Johnston*, *Lovett*, *May King*, *Progress* and *Wonder* were of weak cane growth and bore but a small crop of fruit.

RED RASPBERRIES.

ABBREVIATIONS.

Size.	Form.	Color.	
s small.	r round.	d dark.	o orange.
m medium.	c conical.	r red.	b bright.
l large.	o ovate.	p purple.	

Variety.	Vigor.	Date bloom.	Date first ripe fruits.	Date last fruits.	Productiveness.	Size.	Form.	Color.	Quality.
Brandywine	9	June 17	July 13	July 30	6	m	r	r	8.5
Cuthbert	9	" 21	" 16	" 31	9	l	r c	r	8
Golden Queen	9.2	" 17	" 15	" 31	8.5	l	r c	o	9.5
Hansell	5	" 16	" 11	" 29	7	m	r	d r	9
Kenyon	8.5	" 16	" 12	" 31	8.5	l	r c	d c	9.5
King	9	" 16	" 7	" 30	7.5	l	r c	r	8.5
Loudon	8.5	" 16	" 11	" 31	8.5	l	r c	d c	9.5
Marlboro	8.5	" 15	" 8	" 27	8.5	m	r	r	8.5
Michigan	8	" 12	" 6	" 25	8	m	r	r	9
Miller	7.5	" 16	" 14	" 31	6.5	s	r c	b r	8
Miller's Woodland	9.2	" 12	" 8	" 27	7.5	m	r	r	8.5
Perry's Golden	9	" 17	" 15	" 31	8.5	l	r c	o	9.5
Phoenix	9	" 16	" 9	" 30	8.5	l	r c	d r	9.5
Royal Church	7	" 17	" 12	" 29	5	l	r c	d c	8.5
Stayman No. 1	8	" 19	" 15	Aug. 6	7.5	l	r c	d c	9
Thompson	6	" 16	" 6	July 27	7.5	m	r	d r	9
Turner	9	" 14	" 10	" 28	8	l	c	r	9

NOTES ON VARIETIES.

Cuthbert.—Is still probably the leading market berry all points considered. *Golden Queen* and *Perry's Golden* are quite similar in bush and berry, and have a place as dessert varieties.

Hansell and *Michigan* are early and the fruits are bright in appearance and of fine quality; but *Marlboro* fruits are larger and while not of so good quality are usually produced in greater number, and the latter variety, therefore, is likely to prove more profitable as an early market sort.

Loudon.—Last year this variety ripened one week after Cuthbert; this year it was five days earlier than that sort. The canes are hardy, of good growth and productive. The fruits are large, very attractive in appearance, of high quality and firm. This variety is likely to prove a strong rival of the Cuthbert.

Kenyon appears to be identical with Loudon.

King.—Canes of good growth and healthy, but scarcely productive enough to make the variety profitable. The fruits are large, of fine color, rather dry and somewhat inclined to crumble and drop easily, seeds large. The quality is good though dry.

Miller.—Canes are not of strong growth and but a small crop of fruit was borne. The variety seems to have no points of special merit.

Phoenix.—Received from J. T. Lovett & Co., Little Silver, N. J. Not a large growth of cane, but productive for first year of fruiting. Berry very large, round conical, slightly elongated in form, rich, dark red color, and of very high quality. A variety of considerable promise.

Royal Church.—While the fruits are very attractive in appearance and of good quality, they crumble too easily to be of much commercial value.

Stayman No. 1.—This variety was scarcely so productive as last season. The canes are of stout, upright growth, and do not make enough laterals to bear a large crop of fruit. The berries are large, dark color and of good quality. The variety is very late to ripen and would be valuable to furnish a succession.

Turner.—Is valuable where a very hardy sort is required.

All Summer, *Henrietta*, *Herstine*, *Rivers Yellow* and *Yellow Antwerp* were killed to the ground and bore no fruit.

SUMMARY.

The following varieties of raspberries are the most reliable or promising for central Michigan.

BLACK CAPS.

Palmer for early. *Conrath* and *Kansas* for medium season, and *Gregg* for late. *Older* is excellent for home use. *Black Diamond* and *Mills No. 15*, are very promising.

PURPLE CAPS.

Shaffer and *Columbian* have given good satisfaction while *Beckwith* and *Redfield* are promising new sorts.

RED VARIETIES.

Cuthbert is still the leading variety of this class planted, though the newer sort, *Loudon*, appears superior in some respects. *Marlboro* and *Hansell* have a place as early sorts. *Phoenix* is a promising new variety and *Stayman No. 1* possesses the merit of ripening the bulk of the crop late.

BLACKBERRIES.

A few blackberries were quite severely injured by the winter, but most sorts were in good condition after cutting back in the spring, to bear a large crop of fruit. The frequent rains in July and August prevented the usual drouth occurring during that period and the blackberry crop was one of the largest and best ever grown here.

BLACKBERRIES.

Name.	Vigor.	Date bloom.	Date first ripe fruits.	Date last fruits.	Productiveness.	Weight of berry in ounces.	Quality.
Agawam	7	June 11	July 24	August 27	7.5	1-18	8
Early Cluster	9.5	" 11	" 24	" 27	6.5	1-15	6.5
Early Harvest	8	" 18	" 23	" 23	3	1-18	8.5
Early King	9.8	" 17	" 16	" 6	8.5	1-9	8.5
Early Mammoth	8.5	" 21	" 31	" 26	4	1-6	8
Eldorado	9.8	" 19	" 27	September 4	10	1-12	9
Erie	9.5	" 12	" 26	August 28	8	1-14	7.5
Ford No 1	8	" 19	" 29	" 28	7.5	1-9	7
Jewett	9.5	" 16	" 27	" 30	6.5	1-9	8.5
Kittatinny	9.8	" 18	" 29	September 3	7.5	1-12	8
Lincoln	9.7	" 12	" 30	" 5	9.5	1-12	6.5
Lovett	9.5	" 18	" 30	August 27	8	1-12	6
Minnewaski	9.8	" 11	" 26	" 27	7.5	1-18	7
Ohmer	8	" 21	" 29	" 30	2	1-9	8.5
Snyder	9.8	" 10	" 29	September 4	10	1-12	9
Stone's Hardy	9.8	" 10	" 28	" 3	8	1-12	8.5
Taylor	9.8	" 12	" 29	" 4	9.5	1-12	9
Wachusett	8.6	" 15	" 28	August 30	7	1-18	8.5
Wilson Jr.	9.4	" 12	" 27	" 24	8	1-12	7.5

NOTES ON VARIETIES.

Early Harvest is early and the fruits though small are of good quality. The canes, however, are so lacking in hardiness that the variety is poorly adapted to this section, unless the canes are laid down in winter.

Early King.—The canes are of strong, vigorous, upright growth, and productive. The fruits are large, of good quality and soft when ripe. As the variety is early, it is well worthy of extensive trial. In 1896-7 it badly winter killed.

Early Mammoth.—Canes are of good growth, rather spreading and quite thorny. Fruits are large, long conical and of good quality. This was the first year of fruiting and the fruits were borne on long stems two to three inches long, and scattered singly all along the branch. As the berries were not in clusters, but few were produced. Perhaps the character of fruit-bearing may change when the plants are older.

Eldorado.—The cane growth is of the same general habit as the *Snyder*, though the leaflets are smaller, longer and narrower; the spines are scarcely so long or sharp and the older canes have more of a reddish tinge. The fruits are quite similar in appearance and quality. The past season *Eldorado* ripened a little earlier than the *Snyder*.

Lincoln.—Canes of strong growth, usually light green with slight reddish tinge; spines long and sharp; leaflets large. A few fruits are large, round conical and have very large seeds. The great majority of the fruits are small and imperfectly formed, and drop very easily before fully ripe. A very productive variety, but the fruits are small and poor in quality.

Ohmer.—Bore its first fruits this year and requires further trial.

Snyder and *Taylor* are old and well tried sorts that can usually be relied upon to produce good crops of fruit.

Agawam, Early Cluster, Erie, Ford No. 1, Jewett, Kittatinny, Lovett, Minnewaski, Stone's Hardy, Wachusett and Wilson Jr., while possessing some good qualities, are either lacking in hardiness, are unproductive, or the fruits are too small to sell well in market.

Childs' Everbearing and *White Blackberry* were killed nearly to the ground and no fruit was borne.

GRAPES.

The season of 1897 was very favorable for the grape and nearly all varieties of bearing age gave promise of a large crop of fruit. Owing however, to the numerous depredations committed, it was impossible to get full notes on the time of ripening, quality and productiveness of all sorts grown. A table of varieties is therefore omitted and the following brief notes given.

Berckmans.—The vine was productive, and the clusters, while not large are of good form and compact. The grapes are medium in size, round and a light purplish red color. The berries hang well to stem but are of medium quality. Season with *Concord.*

Brighton.—This is one of the leading red grapes for home use or market. The canes are productive and the fruit and foliage usually quite free from disease.

Chidester No. 4.—Much like *Concord* but a little later in season and the grapes larger. A variety of much promise.

Delaware. —An old sort somewhat liable to mildew but the quality is so superior that the variety should have a place in every home vineyard. Season a week later than *Concord.*

Diamond.—The variety is hardy and productive. Clusters large and compact. The grapes are good size, yellowish green color and of good quality. Season a week earlier than *Concord.* A good sort for the home plantation.

Early Victor.—The canes are of good growth, healthy and productive. The bunches are not large and the grapes are of medium size, blue-black in color and of good quality. The variety is about two weeks earlier than *Concord,* and is worthy of a place in the home vineyard.

Empire State. One of the leading white market grapes. It is not so large in bunch or berry as *Niagara*, but is better in quality.

Geneva.—Healthy and productive. The bunch is of medium size but good form. Berry medium to large, light green in color and of good quality. In season a little earlier than *Concord.* Worthy of trial as a home grape.

Hayes.—The clusters are of medium size, quite close and compact. The berries are a rich golden yellow color and very good in quality. Lacking in productiveness, otherwise a fine table sort.

Janesville.—Healthy and productive. Clusters small and compact. Berry of medium size, black and of fine quality. Too small in bunch and berry to be a profitable sort. It is two or three weeks earlier than *Concord.*

Moore Early.—The variety most largely grown as an early market grape. Season two weeks earlier than *Concord.* The variety is moderately productive; the clusters are of medium size, and the grapes are large, but the quality is rather low.

Niagara.—The leading white market grape. It is vigorous in growth, healthy and productive. The clusters and berries are large and the quality good. It is a little later than *Concord.*

Pocklington.—An excellent yellowish-white grape; a little earlier in season than *Niagara* and the clusters and berries are smaller in size. The quality is better than that of *Niagara*, except that the flavor is quite foxy.

Rockwood.—Clusters small and quite compact. Berries of medium size, blue-black color and of good quality. It is two weeks earlier than *Concord* and has a place in a small way because of its earliness and quality.

Vergennes.—The growth is vigorous and healthy in foliage and fruit. Clusters of good size and compact in form. Berry large; color dark purple with green markings; quality good. The season is a little later than *Concord.* It is a valuable variety because of its good keeping qualities.

Winchell.—The variety is healthy in fruit and foliage. Clusters of good size and compact in form. Berry of medium size, round, color light green, skin thin but firm, pulp sweet, melting and of very fine quality. The variety is fairly productive and two to three weeks earlier than *Concord.* Valuable for home use and of considerable promise as an early market grape.

Worden.—This variety is from a week to ten days earlier than *Concord*, fully as productive and better in quality. This sort should be in every vineyard whether planted for home use or market.

Munson's No. 2, No. 32, No. 38 and No. 61 have been grown for several seasons. The vines are very productive, but the clusters are small, the grapes *very* small, sour and quite late to ripen. The varieties are subject to Phylloxera and have little value in this section.

L. R. TAFT,
H. P. GLADDEN.

AGRICULTURAL COLLEGE, MICH., December 1, 1897.

REPORT OF SOUTH HAVEN SUB-STATION.

Bulletin 152.—Horticultural Department.

Prof. L. R. Taft, Horticulturist:

SIR—In submitting the following report of operations at this sub-station, during the portion of the year 1897 already elapsed, I take occasion to state that, owing doubtless to the exhaustion consequent upon the excessive crop of last year, together with the unusually prevalent low temperatures of the past spring, the fruit crop at this sub-station has, in very many cases, failed to fulfil even its early promise.

Snow fell here, in considerable quantity, as late as April 20, disappearing very slowly, the mercury ranging as low as 21° on the morning of the 21st. The weather continued cold, dry and otherwise unfavorable most of the time, till near the middle of June, at about which time the first copious rains occurred.

A careful examination by yourself, in March last, having betrayed the presence of San Jose scale upon a couple of small pear trees, planted in the spring of 1896, they were at once treated, under your direction, with an application of undiluted kerosene, which effectually exterminated the pest with no apparent injury to the tree-growth, which, at the time, was entirely dormant.

Your examinations at that time also betrayed a considerable prevalence of the Putnam scale. This was, therefore, at once treated with a thorough application of an emulsion of kerosene and whale oil soap, under your direction and supervision, which proved very effective.

In this report, as in preceding ones, the rules of Pomology of the American Pomological Society, which are also adopted by the National Division of Pomology, are as far as practicable applied to the names of the fruits reported.

In applying the spirit as well as the letter of these rules, we are antagonized by several more or less objectionable practices, now common among the originators and introducers of new varieties, and which too frequently prove sources of error in nomenclature, with multiplication of synonyms, and occasionally of objectionable prolixity in names.

Among these we note the following:

1. The disseminating of varieties under numbers, or under the originator's name, with a number attached, which, when permanently named, too frequently becomes the occasion, if not of error, at least of a multiplication of synonyms.

2. The use of coarse, rowdyish, pretentious or sensational names not unfrequently applied with the apparent purpose of promoting sales, with no apparent regard to actual value.

3. The application of specific titles to mere varieties, as in the case of Prunus Pissardi plum.

4. The yet more recent practice of combining the names of two varieties, or even species, and applying such compound name to a variety, notable cases of which occur in Bartlett-Seckel and Worden-Seckel pears, which are paralleled in the name, Dana-Hovey, applied to a fine pear; coupling the name of the originator with that of a noted pomologist, long since deceased.

So seriously objectionable are each and all these practices, that it becomes highly important that they, by some means, be promptly and effectively checked.

The rules, as well as the practice, of both the Society and the Division, accord to the originator the prior right to name his origination; but, at the same time, reserve the right to insist that such name shall be in accordance with the rules.

It is understood to be the practice of the National Division of Pomology to require compliance with such rules, before accepting a new fruit for entry upon its records.

Important and effective as such action unquestionably is, it can be but partially successful without the coöperation of other and similar influences.

It is perhaps too much to expect that the catalogues and horticultural serials of the day can be, to any considerable extent. induced to adopt the practice indicated, but a concurrent refusal by the Experiment Stations of the day, to give publicity to new varieties, until named in compliance with the prescribed rule, coupled with the known practice of the Division of Pomology, could scarcely fail to insure a very general acceptance and adoption of the desired practice.

STRAWBERRIES—*Fragaria*.

The Station grounds are now so densely planted with fruit trees, that the last three plantings of strawberries have unavoidedly been made upon ground partially or wholly preoccupied by fruit trees; more or less of them of bearing age.

Under such conditions, it is assumed that the weight or bulk of the crop cannot fairly express the value of a variety, as compared with others grown under more favorable conditions. For this reason the vigor and productiveness of varieties, as compared with others grown under similar conditions, are estimated upon the scale—1 to 10.

A straw mulch was applied late last autumn, for winter protection, and the plants were sprayed last spring, after removing the mulch, as a preventive against the depredations of insects and fungi. from which, however, the plantations have been notably exempt; the chief exception being the minute larva, commonly known as the *midge*, which, however, yielded to an application of tobacco water, which was applied June 5th. In the last spring's plantation, also a considerable number of plants were destroyed by the grub (*Lachnosterna fusca*), and were at once replaced.

The very warm, dry weather of late June and early July rapidly deteriorated the remainder of the strawberry crop, so that the last picking was made on July 6th, when the one and two year plats (the latter having been fruited the second year for the purpose of comparison), were at once plowed under.

The ground from which the old small fruit plat had been recently removed should doubtless have been liberally manured, and cultivated at least a year before being replanted. But this being the only available ground for the purpose, it was prepared and planted with strawberries last spring, after receiving a light application of unleached ashes—all that could be obtained for the purpose, at the time, and chemical fertilizers.

The weather continuing very warm and dry, on July 19th to 23d, the plat was irrigated from the village water mains by means of a hose, and again on the 28th to 31st.

Taken as a whole, the season can scarcely be considered a favorable one for the strawberry, though a timely rain during the earlier part of the ripening season would probably have added largely to the yield.

Of the numerous varieties of strawberries now before the public, few if any have been carefully described, either by the originators or introducers. Under such circumstances, the receiver of a, to him, unknown novelty, must necessarily depend implicitly upon the correctness and veracity of the person from whom he receives it, so far as its genuineness is concerned. Indeed, so readily is the public accustomed to accept alleged novelties that, in very many cases, the same description would suffice, almost equally well, for a very considerable number of varieties.

It is suggested, that a large expenditure upon worthless novelties would be saved, were the public to require that novelties shall only be accepted upon a description, showing superior and valuable qualities.

As a step toward the accomplishment of this object, the descriptions of both plant and fruit, in the following tabulation, are made as full and minute as practicable, within the space that can be devoted to such purpose, the estimates being made upon the scale—1 to 10, with 10 as the maximum.

Tabulation of Strawberries, 1897.

Abbreviations: b, bisexual; n, nearly; p, pistillate; c, conical; co, compressed; i, irregular; l, long; o, oblate; ob, oblong; r, round; b, bright; c, crimson; d, dark; l, light; s, scarlet. Scale: 1 to 10; 1, feeble; 10, very vigorous.

No.	Names.	Plant.						Fruit.					Remarks.
		Sex.	Vigor. (1-10)	Date of Bloom.	Date of first picking.	Date of last picking.	Product.	Form.	Color.	Quality. (1-10)	Texture. (1-10)	Weight. Ounces.	
1	Acem	b	9	May 12	June 15	July 6	5	r c	l s	5	6-7	¼	Strong, upright.
2	Afton	p	7	" 17	" 24	" 2	8	r o co	c	6-7	8	¼	Tall, upright, rather weak.
3	Allen	b	6	" 12	" 19	" 6	9	ob	c	7	6	⅔	Low, spreading, rather weak.
4	Allen, 5	p	6	" 17	" 17	" 2	4	r c i	c	8	7	¼	Low, spreading, strong.
5	Allen, 6	p	7	" 17	" 24	" 2	5	r o	c	5-6	5	⅓	Upright, spreading, strong.
6	Allen, 13	p	7	" 18	" 22	" 2	8	t c	c	8-9	8	⅓	Low, spreading, weak.
7	Annie Laurie	b	5	" 21	" 26	" 6	4	r o	c	6-7	10	⅓	Low, spreading, weak.
8	Aroma	b	7	" 18	" 21	" 6	9	r c i	c	3-4	4-5	⅓	Tall, spreading, strong.
9	Arrow	p	8	" 18	" 25	" 6	4	r c	d s	3-4	4	½	Tall, upright, strong.
10	Auburn	p	6	" 18	" 24	" 2	6	r c	c	7-8	9 10	¼	Tall, upright, weak.
11	Banquet	p	4	" 14	" 22	" 6	4	r o	d s	6 7	7-8	1-6	Tall, upright, weak.
12	Barton	p	5	" 13	" 24	" 6	7	c co i	d s	4-5	7	¼	Tall, upright, strong.
13	Beebo	b	6	" 17	" 26	" 2	6	r c co	l c	3-4	4	⅓	Tall, upright, strong.
14	Beecher	b	10	" 18	" 22	" 6	9	r ob	c	4-5	4	⅓	Low, spreading, strong.
15	Belt, 3 (Wm. Belt)	b	8	" 15	" 22	" 6	9	c	s	4-5	6	½	Tall, spreading, strong.
16	Beverly	b	7	" 18	" 22	" 6	10	r c i	b s	6-7	8	⅓	Low, strong, spreading.
17	Bickle	p	5	" 16	" 22	" 6	4	r c	s	4-5	7	1-5	Low, weak, spreading.
18	Boynton	p	10	" 17	" 22	" 6	9	r c i	s	6-7	7	1-6	Tall, upright, weak.
19	Brandywine	p	10	" 18	" 22	" 6	10	r c o	c	4-5	9	½	Low, spreading, strong.
20	Brunette	b	8	" 17	" 22	" 6	8	r c o	d c	9-10	9	⅓	Tall, spreading, strong.
21	Bubach, 5	p	9	" 18	" 24	" 6	7	r c co i	s	4-5	4	⅓	Tall, strong, upright.
22	Cameron, 2	b	6	" 13	" 17	" 2	6	r c co	s	6-7	6	⅓	Tall, upright, strong.
23	Cameron, 6	b	6	" 17	" 17	" 2	3	r c	c	3	6	¼	Tall, upright, strong.
24	Cameron, 13	p	6	" 19	" 26	" 2	7	r o c	s	4-5	8	¼	Tall, upright, strong.
25	Carrie	p	7	" 19	" 26	" 6	5	r c co	s	3-4	5	⅓	Tall, upright, strong.
26	Chairs	p	7	" 17	" 17	" 6	6	r c i	s	5	4	¼	Tall, upright, strong.
27	Champion (Eng.)	b	9	" 19	" 28	" 6	10	r c co i	s	3-4	6-7	⅓	Low, spreading, rather weak.
28	Charlie	p	10	" 17	" 22	" 6	8	r c	s	4-5	8	¼	Tall, upright, rather strong.
29	Cheyenne	p	7	" 19	" 26	" 6	6	r c co i	s	6-7	5	⅓	Low, spreading, weak.
30	Clark	b	6	" 17	" 22	" 2	5	r c	c	6-7	8	⅓	Low, spreading, weak.
31	Cleveland	p	7	" 18	" 22	" 6	7	r c co	s	4-5	5	⅓	Low, spreading, strong.
32	Columbia	b	6	" 19	" 22	" 6	10	l c i	s	4-5	4	½	Low, spreading, rather weak.
33	Consensus	p	7	" 20	" 26	" 6	8	r o c co	c	8 9	8	⅓	Tall, upright, strong.
34	Copernicus	p	8	" 19	" 22	" 6	5	r c i	c	4-5	8	⅓	Tall, upright, strong.
35	Crescent	p	9	" 17	" 22	" 6	9	r c i	s	4-5	4-5	¼	Tall, upright, strong.
86	Cruse	b	7	" 17	" 22	" 6	7	r c co	l c	5	9	⅓	Low, spreading, strong.

37	Curtis, 15	b	7	“ 17	“ 18	“ 6	6	r c co	s	5	6	⅓	Tall, upright, strong.
38	Curtis, 159	p	7	“ 17	“ 22	“ 6	8	ob co	s	5	8	⅓	Tall, upright, strong.
39	Cyclone	b	6	“ 15	“ 21	“ 2	5	c co i	c	8	7	⅓	Tall, upright, strong.
40	Daisy	p	6	“ 21	“ 24	“ 6	4	r c co	d s	-7	8	⅓	Tall, upright, weak.
41	Dan Bisel	b	10	“ 14	“ 21	“ 6	10	r c co	d s	8	8	⅓	Tall, upright, strong.
42	Dayton	b	9	“ 18	“ 14	“ 6	9	c i	d s	6-7	4-5	⅓	Low, spreading, strong.
43	Earliest	b	9	“ 12	“ 15	“ 6	6	r c co	s	6-7	10	¼	Tall, upright, strong.
44	Early Jack	b	8	“ 15	“ 22	“ 6	7	r co i	s	4-5	5	¼	Tall, upright, weak.
45	Edgar	p	7	“ 17	“ 23	“ 6	9	r c i	d s	3-4	4	⅓	Low, upright, strong.
46	Edith	p	6	“ 21	“ 28	“ 6	6	r c co	c	8-9	7	½	Low, spreading, strong.
47	Edward (Fav.)	b	6	“ 19	“ 26	“ 6	7	r c	d s	6-7	7	⅓	Short, spreading, weak.
48	Edwards	b	6	“ 13	“ 23	“ 6	8	r c i	l s	5	5	⅓	Low, spreading, weak.
49	Eleanor	b	8	“ 18	“ 20	“ 6	8	r c i	c	6-7	8	¼	Low, spreading, strong.
50	Enhance	b	6	“ 17	“ 23	“ 6	7	c i	c	9	10	⅓	Tall, upright, weak.
51	Epping	p	7	“ 12	“ 15	“ 6	4	c co i	s	3-4	3	⅓	Tall, spreading, strong.
52	Fairmount	b	8	“ 17	“ 18	“ 6	10	r c co	c	7-8	6	¼	Tall, upright, weak.
53	Feicht, 2	b	7	“ 13	“ 23	“ 2	5	r c i	s	5	8	⅓	Low, upright, strong.
54	Feicht, 3	p	7	“ 18	“ 26	“ 6	6	c i	c	3-4	3	¼	Tall, spreading, strong.
55	Fir	b	6	“ 19	“ 23	“ 2	8	r c	s	6-7	8	⅓	Low, spreading.
56	Gardner	b	7	“ 18	“ 23	“ 2	6	o c	c	4-5	6	½	Tall, upright, strong.
57	Gipsy	p	8	“ 18	“ 24	“ 6	6	c i	c	9-10	9	⅓	Low, upright, strong.
58	Glenfield	b	5	“ 15	“ 23	“ 2	8	r c	c	6 7	8	¼	Low, spreading, weak.
59	Greenville	p	10	“ 17	“ 23	“ 6	9	r c co	c	3-4	4-5	¾	Tall, upright, spreading.
60	Harmon	b	8	“ 14	“ 14	June 28	4	c	c	9-10	8	⅓	Tall, upright, strong.
61	Hattie	p	7	“ 17	“ 23	July 6	7	r c i	s	3-4	4	¼	Tall, upright, spreading, strong.
62	Haverland	p	8	“ 13	“ 23	“ 6	7	ob c co	s	8-9	7-8	⅓	Tall, upright, strong.
63	Hermit	b	8	“ 17	“ 23	“ 6	8	r c i	s	5-6	7	⅓	Tall, upright, strong.
64	Holland	p	9	“ 21	“ 25	“ 6	5	r c co	s	3-4	4	⅓	Tall, upright, strong.
65	Hugo	b	4	“ 18	“ 23	“ 2	4	r c i	c	5	8	¼	Low. spreading, weak.
66	Huntsman	b	6	“ 19	“ 24	“ 2	5	r	c	6-7	9-10	⅓	Low, spreading, strong.
67	Hyslop	b	7	“ 13	“ 14	June 28	5	r c	d s	6 7	5-6	⅓	Tall, upright, strong.
68	Iowa	b	2	“ 15	“ 23	“ 28	3	r ob co	c	4-5	5	⅓	Low, spreading, strong.
69	Irene	p	7	“ 21	“ 23	July 6	10	c co i	c	6-7	8	⅓	Low, spreading, strong.
70	Isabel	n, p	9	“ 20	“ 19	“ 6	10	c co i	c	6	9	¾	Tall, upright, weak.
71	J. S., 4	p	8	“ 17	“ 23	“ 6	9	r c co	s	5-6	4	⅓	Tall, upright, rather weak.
72	J. S., 6	p	5	“ 17	“ 25	“ 6	8	r c	s	7-8	7	¼	Low, spreading, weak.
73	Kansas	b	6	“ 17	“ 23	“ 2	7	r c	s	5 6	7	⅓	Tall, upright, weak.
74	Katie	b	8	“ 18	“ 23	“ 6	10	r co	s	3-4	8	⅓	Tall, upright, strong.
75	Klickita	p	7	“ 19	“ 25	“ 6	6	r c	s	7	5	1-5	Upright, tall, strong.
76	Kossuth	b	6	“ 15	“ 23	“ 2	10	r c i	c	5	4-5	¼	Low, spreading, weak.
77	Kyle, 1	b	10	“ 18	“ 24	“ 6	8	r c o	s	4-5	4	⅓	Tall, upright, strong.
78	La Crosse	n, p	6	“ 19	“ 25	“ 6	6	r c	s	4 5	7	1-5	Tall, upright, strong.
79	Leader	b	7	“ 15	“ 25	“ 2	4	r c	c	7-8	9	⅓	Low, spreading, strong.
80	Lehigh	p	7	“ 17	“ 23	“ 6	7	c i	d s	5-6	7	1-5	Tall, upright, strong.
81	Leroy	p	8	“ 17	“ 23	“ 2	8	r c	c	6-7	5	⅓	Tall, upright, strong.
82	Leviathan	b	5	“ 19	“ 23	“ 2	7	c co	s	4-5	4	⅓	Low, spreading, strong.

Tabulation of Strawberries, 1897.

Abbreviations: b, bisexual; n, nearly; p, pistillate; c, conical; co, compressed; i, irregular; l, long; o, oblate; ob, oblong; r, round; b, bright; c, crimson; d, dark; l, light; s, scarlet. Scale: 1 to 10; 1, feeble; 10, very vigorous.

No.	Names.	Plant.						Fruit.					Remarks.
		Sex.	Vigor. (1-10)	Date of Bloom.	Date of first picking.	Date of last picking.	Product.	Form.	Color.	Quality. (1-10)	Texture. (1-10)	Weight. Ounces.	
1	Acem	b	9	May 12	June 15	July 6	5	r c	l s	5	6-7	¼	Strong, upright.
2	Afton	p	7	" 17	" 24	" 2	8	r o co	c	6-7	8	¼	Tall, upright, rather weak.
3	Allen	b	6	" 12	" 19	" 6	9	ob	c	7	6	⅔	Low, spreading, rather weak.
4	Allen, 5	p	6	" 17	" 17	" 2	4	r c i	c	8	7	¼	Low, spreading, strong.
5	Allen, 6	p	7	" 17	" 24	" 2	5	r o	c	5-6	5	⅓	Upright, spreading, strong.
6	Allen, 13	p	7	" 18	" 22	" 2	8	t c	c	8-9	8	⅓	Low, spreading, weak.
7	Annie Laurie	b	5	" 21	" 26	" 6	4	r o	c	6-7	10	⅓	Low, spreading, weak.
8	Aroma	b	7	" 18	" 21	" 6	9	r c i	c	3-4	4-5	⅓	Tall, spreading, strong.
9	Arrow	p	8	" 18	" 25	" 6	4	r c	d s	3 4	4	⅓	Tall, upright, strong.
10	Auburn	p	6	" 18	" 24	" 2	6	r c	c	7-8	9-10	¼	Tall, upright, weak.
11	Banquet	p	4	" 14	" 22	" 6	4	r c	d s	6 7	7-8	1-6	Tall, upright, weak.
12	Barton	p	5	" 13	" 24	" 6	7	c co i	d s	4-5	7	¼	Tall, upright, strong.
13	Beebo	b	6	" 17	" 26	" 2	6	r c co	l c	3-4	4	⅓	Tall, upright, strong.
14	Beecher	b	10	" 18	" 22	" 6	9	r ob	c	4-5	4	⅓	Low, spreading, strong.
15	Belt, 3 (Wm. Belt)	b	8	" 15	" 22	" 6	9	c	s	4-5	6	⅓	Tall, spreading, strong.
16	Beverly	b	7	" 18	" 22	" 6	10	r c i	b s	6-7	8	⅓	Low, strong, spreading.
17	Bickle	p	5	" 16	" 22	" 6	4	r c	s	4-5	7	1-5	Low, weak, spreading.
18	Boynton	p	10	" 17	" 22	" 6	9	r c i	s	6-7	7	1-6	Tall, upright, weak.
19	Brandywine	p	10	" 18	" 22	" 6	10	r c o	c	4-5	9	⅓	Low, spreading, strong.
20	Brunette	b	8	" 17	" 22	" 6	8	r c o	d c	9-10	9	⅓	Tall, spreading, strong.
21	Bubach, 5	p	9	" 18	" 24	" 6	7	r c co i	s	4-5	4	⅓	Tall, strong, upright.
22	Cameron, 2	b	6	" 13	" 17	" 2	6	r c co	s	6-7	6	⅓	Tall, upright, strong.
23	Cameron, 6	b	6	" 17	" 17	" 2	3	r c	c	3	6	¼	Tall, upright, strong.
24	Cameron, 13	p	6	" 19	" 26	" 2	7	r o c	s	4-5	8	¼	Tall, upright, strong.
25	Carrie	p	7	" 19	" 26	" 6	5	r c co	s	3-4	5	⅓	Tall, upright, strong.
26	Chairs	p	7	" 17	" 17	" 6	6	r c i	s	5	4	¼	Tall, upright, strong.
27	Champion (Eng.)	b	9	" 19	" 28	" 6	10	r c co i	s	3-4	6-7	⅓	Low, spreading, rather weak.
28	Charlie	p	10	" 17	" 22	" 6	8	r c	s	4-5	8	¼	Tall, upright, rather strong.
29	Cheyenne	p	7	" 19	" 26	" 6	6	r c co i	s	6-7	5	⅓	Low, spreading, weak.
30	Clark	b	6	" 17	" 22	" 2	5	r c	c	6-7	8	⅓	Low, spreading, weak.
31	Cleveland	p	7	" 18	" 22	" 6	7	r c co	s	4-5	5	⅓	Low, spreading, strong.
32	Columbia	b	6	" 19	" 22	" 6	10	l c i	s	4-5	4	½	Low, spreading, rather weak.
33	Consensus	p	7	" 20	" 26	" 6	8	r o c co	c	8 9	8	⅓	Tall, upright, strong.
34	Copernicus	p	8	" 19	" 22	" 6	5	r c i	c	4-5	8	⅓	Tall, upright, strong.
35	Crescent	p	9	" 17	" 22	" 6	9	r c i	s	4-5	4-5	¼	Tall, upright, strong.
36	Cruse	b	7	" 17	" 22	" 6	7	r c co	l c	5	9	⅓	Low, spreading, strong.

37	Curtis, 15	b	7	" 17	" 18	" 6	6	r c co	s	5	6	⅓	Tall, upright, strong.
38	Curtis, 159	p	7	" 17	" 22	" 6	8	ob co	s	5	8	⅓	Tall, upright, strong.
39	Cyclone	b	6	" 15	" 21	" 2	5	c co i	c	8	7	⅓	Tall, upright, strong.
40	Daisy	p	6	" 21	" 24	" 6	4	r c co	d s	-7	8	⅓	Tall, upright, weak.
41	Dan Bisel	b	10	" 14	" 21	" 6	10	r c co	d s	8	8	⅓	Tall, upright, strong.
42	Dayton	b	9	" 18	" 14	" 6	9	c i	d s	6-7	4-5	⅓	Low, spreading, strong.
43	Earliest	b	9	" 12	" 15	" 6	6	r c co	s	6-7	10	¼	Tall, upright, strong.
44	Early Jack	b	8	" 15	" 22	" 6	7	r co i	s	4-5	5	¼	Tall, upright, weak.
45	Edgar	p	7	" 17	" 23	" 6	9	r c i	d s	3-4	4	⅓	Low, upright, strong.
46	Edith	p	6	" 21	" 28	" 6	6	r c co	c	8-9	7	½	Low, spreading, strong.
47	Edward (Fav.)	b	6	" 19	" 26	" 6	7	r c	d s	6-7	7	⅓	Short, spreading, weak.
48	Edwards	b	6	" 13	" 23	" 6	8	r c i	l s	5	5	⅓	Low, spreading, weak.
49	Eleanor	b	8	" 18	" 20	" 6	8	r c i	c	6-7	8	¼	Low, spreading, strong.
50	Enhance	b	6	" 17	" 23	" 6	7	c i	c	9	10	⅓	Tall, upright, weak.
51	Epping	p	7	" 12	" 15	" 6	4	c co i	s	3-4	3	⅓	Tall, spreading, strong.
52	Fairmount	b	8	" 17	" 18	" 6	10	r c co	c	7-8	6	¼	Tall, upright, weak.
53	Feicht, 2	b	7	" 13	" 23	" 2	5	r c i	s	5	8	⅓	Low, upright, strong.
54	Feicht, 3	p	7	" 18	" 26	" 6	6	c i	c	3-4	3	¼	Tall, spreading, strong.
55	Fir	b	6	" 19	" 23	" 2	8	r c	s	6-7	8	⅓	Low, spreading.
56	Gardner	b	7	" 18	" 23	" 2	6	o c	c	4-5	6	½	Tall, upright, strong.
57	Gipsy	p	8	" 18	" 24	" 6	6	c i	c	9-10	9	⅓	Low, upright, strong.
58	Glenfield	b	5	" 15	" 23	" 2	8	r c	c	6 7	8	¼	Low, spreading, weak.
59	Greenville	p	10	" 17	" 23	" 6	9	r c co	c	3-4	4-5	¾	Tall, upright, spreading.
60	Harmon	b	8	" 14	" 14	June 28	4	c	c	9-10	8	⅓	Tall, upright, strong.
61	Hattie	p	7	" 17	" 23	July 6	7	r c i	s	3-4	4	¼	Tall, upright, spreading, strong.
62	Haverland	p	8	" 13	" 23	" 6	7	ob c co	s	8-9	7-8	⅓	Tall, upright, strong.
63	Hermit	b	8	" 17	" 23	" 6	8	r c i	s	5-6	7	⅓	Tall, upright, strong.
64	Holland	p	9	" 21	" 25	" 6	5	r c co	s	3-4	4	⅓	Tall, upright, strong.
65	Hugo	b	4	" 18	" 23	" 2	4	r c i	c	5	8	⅓	Low. spreading, weak.
66	Huntsman	b	6	" 19	" 24	" 2	5	r	c	6-7	9-10	⅓	Low, spreading, strong.
67	Hyslop	b	7	" 13	" 14	June 28	5	r c	d s	6 7	5-6	⅓	Tall, upright, strong.
68	Iowa	b	2	" 15	" 23	" 28	3	r ob co	c	4-5	5	⅓	Low, spreading, strong.
69	Irene	p	7	" 21	" 23	July 6	10	c co i	c	6-7	8	⅓	Low, spreading, strong.
70	Isabel	n, p	9	" 20	" 19	" 6	10	c co i	c	6	9	¾	Tall, upright, weak.
71	J. S., 4	p	8	" 17	" 23	" 6	9	r c co	s	5-6	4	⅓	Tall, upright, rather weak.
72	J. S., 6	p	5	" 17	" 25	" 6	8	r c	s	7-8	7	¼	Low, spreading, weak.
73	Kansas	b	6	" 17	" 23	" 2	7	r c	s	5 6	7	⅓	Tall, upright, weak.
74	Katie	b	8	" 18	" 23	" 6	10	r co	s	3-4	8	⅓	Tall, upright, strong.
75	Klickita	p	7	" 19	" 25	" 6	6	r c	s	7	5	1-5	Upright, tall, strong.
76	Kossuth	b	6	" 15	" 23	" 2	10	r c i	c	5	4-5	¼	Low, spreading, weak.
77	Kyle, 1	b	10	" 18	" 24	" 6	8	r c o	s	4-5	4	⅓	Tall, upright, strong.
78	La Crosse	n, p	6	" 19	" 25	" 6	6	r c	s	4 5	7	1-5	Tall, upright, strong.
79	Leader	b	7	" 15	" 25	" 2	4	r c	c	7-8	9	½	Low, spreading, strong.
80	Lehigh	p	7	" 17	" 23	" 6	7	c i	d s	5-6	7	1-5	Tall, upright, strong.
81	Leroy	p	8	" 17	" 23	" 2	8	r c	c	6-7	5	⅓	Tall, upright, strong.
82	Leviathan	b	5	" 19	" 23	" 2	7	c co	s	4-5	4	¼	Low, spreading, strong.

Tabulation of Strawberries, 1897.—Continued.

No.	Names.	Plant.						Fruit.					Remarks.
		Sex.	Vigor. (1-10)	Date of Bloom.	Date of first Picking.	Date of last picking.	Product.	Form.	Color.	Quality. (1-10)	Texture (1-10)	Weight. Ounces	
83	Lincoln	p	8	May 18	June 23	July 6	9	c i	s	5-6	5	⅓	Tall, upright, strong.
84	Little, 26	b	10	" 19	" 28	" 6	10	r co	c	7-8	7-8	⅓	Tall, upright, strong
85	Little, 42	b, p	7	" 17	" 23	" 6	8	i co	c	7-8	7-8	⅓	Short, spreading, strong.
86	Longfield	p	8	" 17	" 19	" 6	8	r c	c	7	8	⅓	Tall, upright, strong.
87	Lovett	b	7	" 18	" 19	" 6	10	c co i	c	7-8	8	⅓	Short, upright, rather weak.
88	Lower	b	7	" 17	" 25	" 6	7	r c co	c	4-5	8	½	Tall, upright, spreading, strong.
89	Magnate	p	8	" 18	" 23	" 6	6	l c co	s	5-6	7	⅓	Tall, upright, strong.
90	Marshall	b	8	" 15	" 24	" 6	8	c co i	c	5-6	8	⅔	Tall, upright, strong.
91	Mary	p	6	" 19	" 25	" 6	5	r c	d c	5-6	6-7	½	Tall, upright, strong.
92	Maxwell	b	5	" 15	" 23	" 6	4	r c	d s	4-5	6	⅓	Tall, upright, strong.
93	Mayflower	b	8	" 10	" 24	June 30	7	r c	s	6-7	6 7	¼	Tall, upright, rather weak.
94	Meeks	b	7	" 13	" 23	June 28	5	o c co	c	4-5	8	¼	Tall, spreading, strong.
95	Miller	b	8	" 22	" 25	July 6	9	r c	c	5-6	8	⅓	Tall, upright, strong.
96	Murray	p	6	" 12	" 22	" 6	5	r c co	s	4-5	8	¼	Tall, upright, weak.
97	Muskingum	b	10	" 21	" 23	" 6	10	c co	c	7-8	8	½	Tall, strong, slightly spreading.
98	Mystic	b	7	" 20	" 25	" 6	10	r c co	d s	3-4	8	½	Low, spreading, strong.
99	Noble	b	2	" 13	" 25	June 30	1	r c	s	2-3	4	⅓	Low, spreading, strong.
100	No. 31	b	7	" 19	" 24	" 30	7	r c co	c	9-10	9	⅓	Tall, spreading, upright, strong.
101	Odessa	p	8	" 18	" 28	July 6	6	r c co	d s	4-5	8	⅓	Tall, upright, strong.
102	Ohio Centennial	b	7	" 17	" 25	" 6	8	r c i	d s	3-4	4	⅓	Low, spreading, strong.
103	Ona	p	8	" 18	" 23	" 6	7	r c	s	5-6	7	⅓	Tall, upright, strong.
104	Orange Co.	p	8	" 17	" 22	" 6	6	r	c	5-6	6	⅓	Tall, upright, strong.
105	Oregon 273	b	5	" 17	" 23	" 6	6	r c co	s	4-5	7	⅓	Low, spreading, weak.
106	Orono	p	7	" 17	" 24	" 6	4	i co	c	6-7	5	½	Tall, upright, weak.
107	Oscar	b	5	" 20	" 26	" 6	5	r c co	c	8-9	8	⅓	Low, spreading, strong.
108	Ostego	p	8	" 17	" 26	" 6	5	r	s	4-5	6	1-5	Tall, upright, spreading, strong.
109	Pacific	p	8	" 17	" 23	" 2	7	r c i	s	5-6	5	½	Tall, upright, strong.
110	Paris (King)	b	8	" 17	" 18	" 6	8	r c co	l s	6	8	⅓	Low, spreading, weak.
111	Parker Earle	b	8	" 17	" 25	" 6	10	r c co	d s	4-5	5	½	Tall, upright, strong
112	Pawnee	p	7	" 17	" 23	" 2	8	r c co	l c	6-7	8	½	Tall, upright, spreading, strong.
113	Philip	b	9	" 17	" 23	" 2	10	r c i	c	5-6	8	½	Tall, upright, strong.
114	Phippen	b	8	" 17	" 21	" 6	5	r c i	c	6-7	9	1-6	Tall, upright, rather weak.
115	Plow City	b	5	" 18	" 26	" 2	3	-----	s	3-4	8	¼	Tall, upright, strong.
116	Premium	b	7	" 19	" 28	June 29	1	-----	s	-----	8	-----	-----
117	Price	b	8	" 13	" 23	July 2	10	r c co	s	4-5	10	⅓	Tall, upright, strong.
118	Primate	b	8	" 13	" 23	" 2	7	r c	c	8 9	7	⅓	Short, upright, strong.
119	Princess	p	8	" 12	" 23	" 6	4	r c co	s	4-5	4	⅓	Tall, upright, spreading, strong.
120	Princeton	b	9	" 12	" 25	" 6	5	r c	s	3-4	5	¼	Tall, upright, strong.

121	Richmond	b	6	" 13	" 23	" 6	9	c co i	d c	7-8	9	⅛	Low, spreading, weak.
122	Rio	b	7	" 10	" 23	" 2	9	r c	s	7 8	9	⅓	Tall, upright, strong.
123	Robinson	b	9	" 17	" 25	" 6	9	r c co	s	5-6	9	1-5	Tall, upright, strong.
124	Ruby	b	8	" 12	" 23	" 6	9	r c co	c	5 6	9	½	Tall, upright, strong.
125	Sandoval	b	5	" 17	" 23	" 6	6	c co	d c	8 9	8	⅛	Low, spreading, weak.
126	Saunders	b	10	" 17	" 23	" 6	10	r c co	c	10	10	¾	Tall, spreading, strong.
127	Scarlet Ball	p	10	" 13	" 28	" 6	6	r i	s	6-7	7	⅓	Tall, upright, strong.
128	Sharpless	b	9	" 18	" 23	" 6	8	c co i	c	8-9	5	⅓	Tall, spreading, strong.
129	Shawnee	n, p	10	" 15	" 23	" 6	9	r c	d s	4-5	5	⅛	Low, spreading, strong.
130	Sherman	b	9	" 13	" 22	" 6	10	r	l s	5-6	9	⅓	Tall, spreading, strong.
131	Shuckless	b	8	" 17	" 23	" 6	7	r c i	c	5-6	7	¼	Tall, upright, spreading, strong.
132	Smalley	p	9	" 16	" 23	" 6	10	r c i	s	3-4	7	⅓	Tall, upright, strong.
133	Smeltzer	b	6	" 12	" 23	June 29	7	r c	c	8	7	⅓	Tall, upright, strong.
134	Smith	b	9	" 10	" 23	July 2	8	r c i co	s	3-4	4	⅓	Tall, upright, strong.
135	Snowball	b	10	" 17	" 19	" 6	7	r c	s	4-5	8	⅓	Tall, upright, strong.
136	Southard	b	8	" 12	" 23	" 2	5	r i	s	7-8	7	⅓	Low, spreading, weak.
137	Speece	p	6	" 17	" 23	" 2	6	r c i	c	5-6	6	½	Low, spreading, strong.
138	Splendid	b	8	" 15	" 23	" 6	8	r c	s	3-4	3	½	Tall, spreading, strong.
139	Springdale	b	7	" 18	" 25	" 6	10	l c	c	5-6	8	½	Low, spreading, strong.
140	Stahelin	p	9	" 10	" 23	" 2	6	c i	l c	5	5	⅛	Tall, upright, spreading, strong.
141	Standard	b	10	" 15	" 23	" 6	9	r c	s	2-3	6	⅛	Low, spreading, strong.
142	Staples	b	9	" 17	" 18	" 6	7	r c i	d c	7-8	7-8	¼	Low, spreading, strong.
143	Stewart	b	10	" 10	" 15	" 6	6	r c co	s	5	9	¼	Tall, upright, strong.
144	Sunnyside	p	10	" 17	" 22	" 6	6	r c	s	2-3	3	⅓	Tall, upright, spreading, strong.
145	Surprise	b	8	" 17	" 25	" 6	6	r c	c	3-4	6	½	Tall, upright, strong.
146	Swindle	p	10	" 17	" 25	" 6	7	r c	s	4-5	8	⅓	Tall, upright, strong.
147	Tennessee	b	7	" 15	" 23	" 6	6	r c	c	7	6	⅓	Tall, upright, strong.
148	Thompson 40	p	9	" 17	" 25	" 6	5	r c	s	4-5	6	⅓	Tall, upright, strong.
149	Thompson 66	p	8	" 19	" 25	" 6	4	r	c	4-5	7	1-6	Tall, upright, rather weak.
150	Timbrel	p	6	" 20	" 25	" 6	7	c i	c	8	8	⅓	Tall, upright, strong.
151	Tom Walker	p	9	" 15	" 25	" 6	7	r c	c	4-5	6	¼	Tall, upright, weak.
152	Tonga	p	8	" 12	" 25	" 6	6	r c	c	7 8	7	⅓	Rather low, upright, strong.
153	Topeka	b	8	" 15	" 23	" 6	8	l c co	d s	4 5	8	¼	Tall, upright, strong.
154	Tubbs	b	8	" 13	" 29	June 30	5	r c	d s	4-5	4	⅓	Tall, upright, strong.
155	Van Deman	b	8	" 10	" 19	July 6	10	c i	c	10	8	½	Tall, upright, strong.
156	Warfield	p	8	" 17	" 25	" 6	9	c co	c	6 7	6	¼	Tall, upright, rather weak.
157	Welton	b	8	" 17	" 26	" 6	7	r c	d s	2-3	4	¼	Low, spreading, strong.
158	Weston	p	7	" 17	" 26	" 6	8	r c	c	3-4	8	⅓	Tall, upright, rather weak.
159	Williams	b	10	" 20	" 23	" 6	10	r c co	c	9-10	9-10	⅛	Low, spreading.
160	Wilson	b	9	" 17	" 23	" 6	10	r c	s	5-6	9	¼	Low, spreading, strong.
161	Wood (Beder)	b	9	" 17	" 25	" 6	10	r c	s	3 4	4-5	⅓	Tall, rather spreading, strong.
162	Woolverton	b	9	" 20	" 23	" 6	10	r c	c	9	9	⅛	Low, spreading, strong.
163	Wyatt	b	7	" 17	" 22	" 6	6	r c	c	5-6	8	⅓	Tall, upright, strong.

The dates of the blooming and ripening of strawberries, as has been already stated, have been unusually modified by climatic causes. While occasional varieties struggled into bloom during the unusually cool weather of early May, the sudden advent of very warm weather soon after, forced the delayed varieties into bloom almost in a mass.

The ripening season also, though dry, continued cool till near the end of June, when, though still dry, it suddenly became very warm, with the effect that much of the yet unripe fruit was dried upon the vines, thus bringing the picking season to a premature close. The estimates of productiveness, under these conditions, are to be understood as essentially a comparison of results, between the varieties tabulated during the current season.

Of the varieties betraying lack of vigor, sixteen are pistillate or nearly so, and the remaining twenty-one are bisexual, thus giving a slight preponderance to the popular assumption, that the non-production of pollen conserves the vigor, or ultimates in increased productiveness.

Of the 163 varieties tabulated, 124 rank above medium, so far as productiveness is concerned, while only 37 equal or exceed the old Wilson in quality, when grown under the same conditions.

The tabulation includes forty-five varieties graded as high as nine for productiveness, while of these four only rank as high as nine in quality, with five others in the tabulation, of equal quality, but more or less deficient in productiveness—a not very creditable comment upon the greed of buyers and consumers for size and quantity, in disregard of quality, as well as on the strife of growers for present returns, in disregard of ultimate reputation and profit.

Owing, apparently, to exceptional climatic influences, a considerable number of varieties which have been for a considerable time on trial without specially favorable results, have this season been unusually productive.

The following is an abstract of the grading for quality of those ranking nine to ten for productiveness:

2 to 3—Standard.

3 to 4—Aroma, Champion (Eng.), Edgar, Greenvillle, Katie, Mystic, Smalley and Wood (Beder).

4 to 5—Beecher, Belt 3, Brandywine, Columbia, Crescent, Parker Earle, Price and Shawnee.

5—Kossuth.

5 to 6—J. S. 4, Lincoln, Miller, Philip, Robinson, Ruby, Sherman, Springdale and Wilson.

6—Isabel.

6 to 7—Beverly, Boynton, Dayton, Irene and Warfield.

7—Allen.

7 to 8—Fairmount, Little 26, Lovett, Muskingum, Richmond and Rio.

8—Bisel.

9—Woolverton.

9 to 10--Williams.

10—Saunders and Van Deman.

Of the varieties with a favorable record for the past trying season, and which bring a promising record from previous trials, we may name Warfield, as still maintaining its previous standing, together with the comparatively recent varieties—Isabel (No name), sent out by Thompson's Sons, Rio Vista, Va., and Saunders and Woolverton, two recent seedlings, originated by Mr. John Little of Ontario. The last three seem worthy of trial, as market varieties.

RASPBERRIES.—*Rubus.*

As a means of avoiding the intermixing of the suckering varieties, these are planted in plats alternating with blackberries and blackcaps.

The raspberries, in common with the entire plantation, received a spray of strong copper sulphate dissolved in water, while yet dormant, as a preventive of fungus, which has been notably absent, with the exception of a slight attack of anthracnose, which was promptly treated with a spray of Bordeaux.

Insects also have been notably absent, so far as this fruit is concerned.

The early promise of fruit was very good; but the occurrence of hot, dry weather during the ripening season, dried and nearly or quite ruined a large share of the crop, though a copious rain came in time to save a portion of such varieties as were not already past recovery.

The weight of an average berry is given in fractions of an ounce.

Productiveness and quality are expressed upon the scale, 1 to 10; the latter being the maximum.

Tabulation of Raspberries, 1897.

Abbreviations: c, conical; o, oblate; ob, oblong; r, roundish; b, blackish; p, pubescent; pu, purplish; r, red; y, yellow.

No.	Names.	Plant.					Fruit.				Remarks.
		Species.	Bloom.	First picking.	Last picking.	Product.	Form.	Color.	Av. berry in fractions of an inch. Weight.	Quality. (Scale 1-10.)	
1	Ada	Occidentalis	June 17								Worthless.
2	Brandywine	Strigosus	" 15	July 13	Aug. 21	8	r c	c	⅛	7	Formerly popular for market.
3	Cardinal	Neglectus	" 12	" 12	" 13	10	r c	c	1-20	6-7	Both suckering and tiprooting.
4	Carman	Occidentalis	" 2	" 12	" 29	10	r	b	1-20	5	Not relatively valuable.
5	Caroline	Neglectus	" 9	" 12	" 7	10	r	y	1-30	2-3	Low quality: productive.
6	Centennial	Occidentalis	" 8	" 12	" 31	9-10	r	b	1-20	6-7	Not comparatively valuable.
7	Champlain	Strigosus									Not yet in fruit.
8	Church	Strigosus	June 9	July 13	Aug. 23	7	r	pu	1-15	7-8	A slender grower.
9	Clark	Occidentalis									Not yet fruiting.
10	Columbian	Neglectus	June 14	July 16	Aug. 13	7-8	r o	pu	1-16	3-4	For canning.
11	Conrath	Occidentalis	" 10	" 12	" 31	10	r	b	1-20	5	One of the earliest.
12	Cromwell	Occidentalis	" 7	" 10	" 27	10	r	b	1-20	5	Similar to the foregoing.
13	Cuthbert	Strigosus	" 9	" 12	" 13	6	c	c	1-14	5-6	Most popular of the reds.
14	Diamond	Occidentalis	" 10	" 16	" 6	7-8	r o	b	1-18	7-8	Promising.
15	Doolittle	Occidentalis	" 8	" 12	" 12	10	r	b	1-22	5-6	The pioneer blackcap.
16	Earhart	Occidentalis	" 8	" 12	" 27	9	r	r	1-25	5-6	Autumn fruiting.
17	Early King	Strigosus	" 7	" 12	" 13	7	r	r	1-15	7-8	New and very promising.
18	Emmett	Neglectus	" 15	" 13	" 2	8	r	pu	1-23	3-4	New.
19	Eureka	Occidentalis	" 10	" 12	" 31	10	r o	b	1-18	5-6	Very valuable.
20	Farnsworth	Occidentalis	" 8	" 12	" 6	10	r o	b	1-30	4-5	Promising.
21	Gault	Occidentalis									Not yet fruited.
22	Gladstone	Neglectus	June 9	July 12	Aug. 29	7	r c	pu	1-32	4-5	Double cropper, but worthless.
23	Golden Queen	Strigosus	" 11	" 13	July 29	7	r c	y	1-16	7-8	Excellent for home use.
24	Green	Occidentalis	" 4	" 12	Aug. 6	10	r	b	1-27	5-7	Of doubtful value.
25	Gregg	Occidentalis	" 11	" 14	" 6	9	r o	p b	1-20	5-6	Productive. Plant tender.
26	Hansell	Strigosus	" 3	" 7	" 5	5	r	c	1-17	5-6	Earliest red variety.
27	Herstine	Idæus hyb.?	" 7	" 10	Sept 6	9-10	r o	r	1-13	9-10	Best red. Plant tender.
28	Hilborn	Occidentalis	" 10	" 12	Aug. 3	10	r o	b	1-29	5-6	Of superior quality.
29	Idaho	Occidentalis	" 12	" 17	" 2	10	r o	b	1-14	5-6	Of doubtful value.
30	Indiana	Occidentalis	" 7	" 15	" 2	10	r o	b	⅛	5-6	Has not become popular.
31	Mayberry	Microphyllus									Not yet fruited.
32	Japanese Wineberry	Phœnicolasius	June 23	Aug. 2	Sept.		r o	r	1-40	1-2	Very vigorous, but worthless.
33	Johnston	Occidentalis	" 10	July 13	Aug. 31	10	r o	b	1-23	4-5	Fruit too seedy.
34	Kansas	Occidentalis	" 10	" 12	" 31	10	r o	b	1-23	4-5	Increasingly popular
35	Kenyon	Strigosus	" 10	" 12	" 27	6-7	r	r	1-13	5-6	New, promising.

36	Logan	Hyb. Idæus Ursinus	June 9								Not yet fruiting.
37	Loudon	Strigosus	“ 10	July 13	Aug. 21	5-6	r	r	1-15	4-5	Very promising.
38	Lovett	Occidentalis	“ 9	“ 13	“ 31	10	r	b	1-30	10	Needs farther trial.
39	Marlboro	Strigosus Idæus	“ 9	“ 10	“ 9	8	r	r	1-16	5-6	Low quality. Market.
40	Miller	Strigosus	“ 9	“ 10	“ 21	5-6	r c	r	1-15	7-8	New, very promising.
41	Mills 16	Occidentalis	“ 10	“ 17	“ 5	10	r	b	1-18	6-7	New, needs farther trial.
42	Muskingum	Neglectus	“ 15	“ 19	“ 13	9-10	r o	pu	1-12	5-6	Much like Shaffer.
43	Nemaha	Occidentalis						b			Not yet in fruit.
44	Ohio	Occidentalis	June 7	July 12	Aug. 31	10	r	b	1-28	6-7	Very seedy.
45	Older	Occidentalis	“ 7	“ 14	“ 7	9-10	r	b	1-19	4-5	Good market blackcap.
46	Onondaga	Occidentalis									Not yet well tested.
47	Otis	Neglectus	June 15	July 19	Aug. 29	10	r	pu	1-13	4-5	Vigorous.
48	Palmer	Occidentalis	“ 8	“ 10	“ 29	10	r	b	1-28	7-8	Superior, early.
49	Phœnix	Occidentalis	“ 10	“ 12	“ 9	5	r	b	1-15	5-6	Needs farther trial.
50	Progress	Occidentalis	“ 8	“ 10	July 31	9-10	r	b	1-20	5-6	Nearly superseded.
51	Redfield	Neglectus	“ 6	“ 15	Aug. 2	9	r	pu	1-26	3-4	New, western.
52	Reeder	Strigosus	“ 9	“ 12	“ 6	5-6	r c	r	1-[illegible]	8-9	Superior for desert.
53	Reliance	Strigosus	“ 9	“ 12	“ 14	6-7	r	pu r	1-27	4-5	Acid. Very hardy.
54	Sarah	Strigosus									Not yet in fruit.
55	Shaffer	Neglectus	June 15	July 19	Aug. 13	10	r	pu	1-16	5-6	One of the best for canning.
56	Smith *Giant*	Occidentalis									Not fruiting.
57	Smith *Prolific*	Occidentalis	June 10	July 15	July 31	7-8	r	b	1-22	7-8	An Ontario seedling.
58	Souhegan	Occidentalis	“ 8	“ 10	“ 27	10	r	b	1-24	5-6	Old. Very early.
59	Strawberry-Raspb'y	Rosæfolius	“ 23	“ 29	Oct. 4	1	r ob	r	1-6	2-3	A curiosity only.
60	Superlative	Idæus	“ 9	“ 10	Aug. 2	6	c	r	1-10	4-5	Origin foreign.
61	Thompson	Strigosus	“ 9	“ 7	“ 6	6-7	r	r	1-22	4-5	Of doubtful value.
62	Thwack	Strigosus	“ 10	“ 10	“ 17	6-7	r	r	1-15	5-6	A market variety.
63	Turner	Strigosus	“ 17	“ 12	“ 9	5	r c	r	1-22	8-9	Nearly superseded.
64	Tyler	Occidentalis	“ 8	“ 10	July 31	10	r	b	1-24	5-6	Like Souhegan.
65	Winona	Occidentalis	“ 7	“ 12	“ 27	6-7	r o	b	1-24	4-5	Of uncertain value.

Notices are appended of such varieties as are, or promise to become desirable for either the home garden or for commercial planting, as well as of certain more recent ones not yet fully tested.

For convenient reference they are alphabetically arranged, as far as practicable, by their recognized common names, and also designated specifically.

AMERICAN RED RASPBERRIES—*R. strigosus.*

(*Including possible and supposed hybrids with R. Idæus.*)

Brandywine, Cuthbert, Early King, Hansell, Loudon and Miller rank as more or less desirable commercial varieties.

Church is large, and of high, sprightly flavor, but so inclined to crumble in picking, as to be quite objectionable. The plant also lacks vigor and productiveness.

Gladstone, sent forth, years since, under an honored name, produces a crop of fruit at the usual season, and a second one, in autumn, upon the current season's canes, but both are practically nearly or quite worthless, at least in our northern climate.

Golden Queen is merely a yellow Cuthbert, in plant as well as in fruit. It is the best of the yellow, suckering varieties; though, unfortunately, somewhat lacking in productiveness. It is well worth a place in the home plantation.

Marlboro and Thwack are regarded as hybrids. Both are of rather low quality. They are popular on account of size, and perhaps productiveness and good handling qualities.

Reeder, next to Herstine, is large, excellent, and fairly productive. The best of the red varieties for the home plantation.

Turner, though very hardy, and of excellent quality, is too small and unattractive in appearance. It is nearly or quite superseded.

BLACKCAPS.—*R. occidentalis.*

Conrath, Cromwell, Souhegan, Tyler, Doolittle and Palmer are among the earliest of the species. Of these, Palmer has, so far, proved superior in size and productiveness, though others approach it very nearly in these respects.

Earhart is desirable, if at all, for its habit of producing a second crop of fruit, in autumn, upon the current season's canes, which, however, in this climate, is quite liable to be ruined by frost while yet immature.

Eureka, Gregg, Kansas, Nemaha, and several others are valuable as medium to late commercial varieties.

Hilborn is of superior quality; and for this reason, desirable for the home plantation, for those who prefer blackcaps.

Johnston and Ohio are productive and popular for evaporating, yielding, as they do, an unusually large percentage of the dried product, which, however, is mainly due to their excessive seediness.

A very considerable number of the tabulated varieties of this species, though for several years before the public, and of nearly or quite average quality and actual value, seem likely never to win popularity, and may perhaps, be dropped from our lists, while others, yet more recent, require a longer trial to determine their true status.

EUROPEAN RASPBERRIES—*R. Idæus.*

Also including possible hybrids.

Herstine (a possible hybrid between *Idæus* and *strigosus*), although rarely injured by the cold of our lake shore winters, is generally safer with slight protection. The fruit is large, bright red, and of excellent quality—a fruit for the home garden.

Superlative is scarcely yet properly tested here. The fruit is unusually elongate-conical; and of mild favor.

INTERMEDIATE AMERICAN RASPBERRIES—*R. Neglectus.*

Muskingum and Shaffer are chiefly valued as superior canning varieties, and several others of this species are similarly useful; while others, yet but partially tested, may be regarded as promising for similar purposes. As a species, their dull color and "smoky" appearance are objectionable.

By many persons it is assumed that this species is the result of accidental hybridization, probably between *R. occidentalis* and *R. strigosus.*

JAPANESE MAYBERRY—*R. microphyllus*; Syn., *R. palmatus.*

This was originated by Luthur Burbank, of Santa Rosa, California, as an improved *R. palmatus*, its parentage being *R. palmatus*, pollinated with Cuthbert pollen. *R. palmatus* being a synonym of *R. microphyllus*, that is retained as the leading specific name.

The plant has not yet fruited here; and its hardiness here is doubtful. It will receive protection during the coming winter.

JAPANESE WINEBERRY—*R. phœnicolasius.*

This has now been on trial here for several years, and the plants prove entirely hardy in this lake shore climate. The foliage is healthy and the plant vigorous. The bloom also is large, showy and abundant, but the fruit, though bright colored, is practically worthless.

Reports, from diverse sources, indicate that other varieties, of much higher quality, are in cultivation; and it seems probable that a batch of seedlings, of varying quality, have been distributed.

LOGAN—*R. ursinus. X R. Idæus.*

This is supposed by the originator to be the result of hybridization as above, although, till quite recently, hybridization between species has been very rare.

It has not yet fruited here, and its hardiness is yet somewhat in doubt.

STRAWBERRY-RASPBERRY—*R. rosæfolius*; Syn., *R. sorbifolius*.

This is herbaceous in habit, increasing, as does quack grass and Canada thistle by underground stolons, for which reason it may, perchance, even become a troublesome weed.

Here it grows to the height of two feet or more, and blooms and fruits sparsely till frost. The blossoms are single, but large and showy, and the fruit beautiful, but worthless. It matured specimens here, this season, as late as the middle of October.

For the specific names of the foregoing recent novelties, the writer is indebted to Assistant Pomologist Wm. A. Taylor, of the National Department of Agriculture, and to Professor L. R. Taft, of the Michigan Agricultural College.

BLACKBERRIES—*Rubus villosus*.

The plantation was treated in early spring, while growth was yet dormant, with a strong solution of copper sulphate as a preventive of fungus.

The only insect which has proved troublesome during the past season is the leaf miner, which has been increasingly abundant for several years past. Specimens of this insect and its work, were sent to the Entomological Division of the National Department of Agriculture, and there reported to be, probably, *Lithocolletis ænea;* but with the statement that little is known of its habits, and that no better method of attacking it can be advised, than that we have already pursued—the prompt gathering and burning of the affected foliage, which is unavoidably a slow and expensive process; especially since there is, apparently, a second brood, necessitating a repetition of the process.

The stand of plants is now in its third year since replanting, but owing, at least in part, to repeated and severe drouths, and also to the custom of originators and introducers, of sending an insufficient number of plants for a trial stand, a comparison of varieties, based upon total products is, in many cases, impracticable, for which reason resort is had to comparative estimates.

Severe drouth, during the growing and ripening season, nearly or quite ruined the fruit of many varieties, though a timely rain served to revive such as were not already past help.

In the following table, as well as throughout this report, specific names, as well as objectionable words employed in naming fruits, are italicised; and the latter are dropped in all cases when not necessary to insure identity:

Tabulation of Blackberries, 1897.

No	Names.	Plant.					Fruit.				Remarks.
		Planted.	Bloomed.	First picking.	Last picking.	Product.	Form.	Color.	Weight. Ounces.	Quality. Scale (1-10)	
1	Agawam	1888	June 11	July 31	Aug. 28	5	r o i	b	1-5	7-8	Not sufficiently productive.
2	Ancient Briton	1888	" 7	" 31	Sept. 10	10	o	b	1-6	8-9	Productive, but lacks size.
3	Childs *Tree*	1888	" 17	" 29	Aug. 27	7	r ov	b	1-8	4-5	Its value not yet determined.
4	Early Harvest	1888	" 11	" 22	" 27	10	o	b	1-15	5-6	Lacks hardiness.
5	Early King	1890	" 9	" 22	" 10	7	o i	b	1-14	7-8	A berry for the home garden.
6	Early Mammoth	1888	" 7	" 30	" 27	10	o i	b	1-9	6-7	An early market berry.
7	El Dorado	1894	" 9	" 29	" 25	8	o ov	b	1-13	6-7	Variably productive.
8	Erie	1888	" 12	Aug. 2	Sept. 8	10	o	b	1-7	4-5	Large, showy, plant very thorny.
9	Fruitland	1893	" 15	" 12	" 8	9	r o	b	1-8	4-5	Only partially tested.
10	Kittatinny	1888	" 14	July 31	" 8	10	o i	b	1-9	7-8	Old, flavor superior.
11	Knox	1888	" 12	" 27	" 8	10	o	b	1-6	6-7	Large, hardy; lacks productiveness.
12	Lawton	1888	" 14	" 31	" 8	10	o	b	1 6	6-7	Still valued for market.
13	Lincoln	1893	" 9	Aug. 4	" 13	10	r ov	b	1-10	8 9	Requires further trial.
14	Lovett *Best*	1896	" 15	" 2	" 12	4	r	b	1-13	5-6	But partially tested.
15	Maxwell	1894	" 11	July 29	" 16	8	r o	b	1-9	5-6	Promising.
16	Minnewaska	1888	" 12	Aug. 2	" 13	10	r o	b	1-7	5-6	A market variety.
17	Nevada	1888	" 14	July 31	" 16	10	o	b	1-6	5-6	Rather variable.
18	Ohmer	1893	" 9	" 30	" 10	10	r ov	b	1-6	6-7	From Ohio; try further.
19	Otis	1897						b			Not yet in fruit.
20	Oregon *Everbearing*	1893	" 23	Aug. 16	" 10	7	o	b	1-12	5-6	A curiosity; cut leaved.
21	Piasa	1895	" 12	July 31	Aug. 17	6	o i	b	1 16	5-6	Its first fruiting.
22	Reyner	1896	" 8	Aug. 2	" 31	5	o ov	b	1-9	5-6	New, promising.
23	Sanford	1894	" 8	" 4	" 23	7	o r ov	b	1-13	4-5	Not fully tested.
24	Snyder	1888	" 9	July 31	" 25	10	o i	b	1-9	9-10	Rather small, very hardy.
25	Taylor	1888	" 9	" 31	Sept 10	10	r o	b	1-8	9-10	Good, hardy; valuable.
26	Thompson	1888	" 11	" 29	Aug. 23	7	o i	b	1-7	3-4	Value doubtful.
27	Triumph *Western*	1888	" 10	Aug. 2	" 25	10	r o	b	1 12	4-5	Hardy, productive; too small.
28	Wallace	1888	" 12	July 30	" 27	10	o	b	1-8	6-7	Large, good, hardy.
29	Wilson	1888	" 10	" 30	" 23	10	o i	b	1-8	3-4	Large, low quality; tender.
30	Wilson, Jr.	1888	" 10	" 30	" 27	10	o i	b	1-10	3-4	Large, low quality; tender.

DEWBERRIES—*R—Canadensis.*

1	Austin	1896									From Texas; not yet fruited.

Abbreviations: i, irregular; o, oblong; ov, ovate; r, roundish; b, black

Agawam, Knox and Wallace are fairly hardy, large, and of good quality; but scarcely productive enough to be popular for market planting.

Ancient Briton and Triumph *Western*, are vigorous, very hardy and productive, but quite too small for market unless under high culture, severe pruning and liberal fertilizing.

Childs *Tree* has done unusually well the past season, but so far does not seem entitled to the name "*tree*," and must continue to improve to win popularity.

Early Harvest is tender, and needs winter protection, even at the lake shore.

Early Mammoth, though possessing good qualities for the market, has so far, failed to win popularity.

Early King, El Dorado, Erie, Lincoln, Minnewaska, Nevada and Thompson, occupy a sort of middle ground between success and failure.

Fruitland, Lovett, Maxwell and Ohmer are not yet fairly past the probationary stage.

Kittatinny, Lawton, Snyder, Taylor, Wilson and Wilson Jr. have long been popular with planters, and seem likely to maintain such position for an indefinite period.

Otis, Piasa, Reyner and Sanford are yet too recent to have given reliable indications of their true character.

Oregon *Everbearing* is a cut leaved variety from the Pacific coast. It has no value here, save perhaps as a curiosity.

Of those mentioned, Kittatinny, Snyder and Taylor rank highest in quality, and are specially desirable for the home plantation, while they are also among the more profitable market varieties.

Of Dewberries, the Austin is highly praised in the place of its origin, at the south, but it can scarcely be expected to excel or even equal the Lucretia, which was introduced and found successful many years since. Indeed it can scarcely be expected that this fruit can ever become popular, save perhaps as a means of opening the blackberry season a few days earlier.

SERVICE BERRY—*Amelanchier*.

SYNONYMS—JUNE BERRY, SHAD BUSH.

The varieties so far tested here are dwarfs, making growths not more than four or five feet in height.

Common is so designated since it was originally received without name.

Success is the variety introduced, several years since, under this name. It differs very slightly, if at all, from the foregoing.

Mammoth, received more recently, from Indiana, was, at the first, apparently, somewhat more vigorous than the others; but, more recently, these varieties differ very little, if at all, in this or any other respect.

A plant, received this season, from the Department of Agriculture, at Washington, as a supposed distinct variety, has not yet grown sufficiently to develop any distinguishing peculiarities.

Birds are especially fond of this fruit, which, in appearance, is very similar to that of the native huckleberry, although by no means equaling it in quality. If planted in sufficient quantity, it might become the means of diverting the attacks of birds from other and more important fruits of the same season.

CURRANTS.—*Ribes.*

The stand of currants, having been transplanted two years since, is not yet at its best, so far as the yield of fruit is concerned, while it is also true, that several of the newer varieties have not yet a full stand of plants.

On March 29th, foliage being yet dormant, the plants were sprayed with a solution of one pound of copper sulphate, in twenty-five gallons of water.

The spray of potassium sulphide, used to prevent mildew of gooseberries, proves effective also in preventing loss of the foliage of currants, for which reason a spray of this has been occasionally applied to the currants also.

On May 29th, aphides having appeared on the foliage of currants they were treated with a decoction of tobacco stems in water, the same being directed upon the under side of the leaves where only these insects occur.

The imported currant borer—*Ægeria tipuliformis*, which has, for several years, proved a very troublesome enemy of the currant throughout this region, has been persistently attacked by cutting away and burning the infested twigs. This has already so reduced their numbers that a careful examination, in early November of the present year, only detected a single larva.

The currant worm—*Nematus ventricosus*, appeared at the usual season but yielded readily to the usual treatment with a spray of buhach in water. This is considered preferable to the usual poisonous applications, since it must be applied when the fruit is near ripening.

TABULATION OF CURRANTS.—*Ribes rubrum* and *nigrum.*

Names.	Origin.	Planted.	Bloomed.	Ripe.	Productiveness.—Scale 1 to 10.	Form.—r, roundish.	Color.—b, black; r, red; w, white.	Quality.—Scale 1 to 10.	Weight of cluster in ounces.	Use d, dessert; k, kitchen; m, market.
Champion	England	1889	May 10	July 17	8	r	b	5-6	1-6	m k
Cherry	Europe	1888	" 4	" 7	10	r	r	5-6	⅓	m
English	England	1892	" 10	" 14	10	r	b	5-6	¼	m k
Fay	New York	1888	" 5	" 10	10	r	r	6-7	⅓	m k
Holland	Europe	1889	" 10	" 25	------	r	r	5	------	m k
Lakewood	Ohio	1890	" 6	" 10	10	r	r	6-7	⅓	m k
Lee	America?	1888	" 10	" 17	10	r	b	3-4	¼	m k
London	England	1890	" 4	" 10	10	r	r	4-5	⅓	m k
Naples	Europe	1888	" 4	" 10	10	r	b	5-6	⅓	m k
North Star	Minnesota?	1890	" 4	" 19	10	r	r	6-7	⅓	m k
Red Dutch	Europe	1888	" 4	" 19	10	r	r	7-8	⅓	d k
Ruby Castle	Europe?	1892	" 4	" 15	7	r	r	6-7	1-5	d k
Ruby *Moore*	New York	1890	" 4	" 17	10	r	r	7-8	⅓	d k
Saunders	Ontario	1890	" 10	" 14	10	r	b	3-4	1-7	m k
Select *Moore*	Massachusetts?	1890	" 4	" 10	10	r	r	5-6	⅓	m k
Versaillaise	France	1888	" 5	" 10	10	r	r	6-7	¼	m k
Victoria	England	1888	" 8	" 10	10	r	r	5-6	⅓	m k
Wales *Prince*	Ontario?	1890	" 10	" 10	10	r	b	5-6	1-6	m k
White Dutch	Europe	1888	" 5	" 10	10	r	w	10	¼	d k
White Gondoin	Europe	1890	" 5	" 10	9	r	w	9	⅓	d k
White Grape	Europe	1888	" 4	" 10	10	r	w	7-8	¼	d k m
Wilder	New York	1890	" 4	" 10	10	r	r	6-7	⅓	m k

Botanically, the red and the white currants are both included in the species—*rubrum*; and the black, fetid varieties belong to the species—*nigrum*. Since, therefore, the color of the fruit unmistakably indicates the species, the botanical column is omitted from the tubulation.

The black currants, *R. nigrum*, are all very much alike in quality as well as in productiveness as grown here; but Naples stands easily at the head of the list, so far as vigor of the plant is concerned.

Crandall, *R. aureum*, has been dropped as valueless, for any practical purpose, and was not included in the recent replanting of currants.

Cherry and Fay, though by no means superior if even equal to others in quality, or even in productiveness, are large, and for this reason only are popular with commercial planters.

Holland possesses great vigor of plant, as well as persistency of foliage, while it compensates for its rather small berry in length of cluster, together with productiveness. It is a popular market variety at the west.

Lakewood and Wilder have the characteristic foliage, as well as the large fruit of Cherry and Fay, though in most seasons they have not equaled them in productiveness.

London *Red*, sometimes called *London Market*, is very vigorous and productive, and for these reasons somewhat popular as a market variety, though neither very large nor of high quality.

North Star is of recent origin and the plant very vigorous, though, so far, it has not proved superior in other respects.

Red Dutch, though among the very oldest varieties, is scarcely equaled, all things considered, by any modern ones. Under proper, liberal treatment, it very nearly equals Cherry in size, and is superior to it in flavor.

Ruby Castle and Ruby *Moore* are amateur varieties; the latter, especially, being superior in quality.

Select *Moore* is, in fruit, much like Cherry, but quite superior to that variety in quality.

Versaillaise, though somewhat distinct in habit of growth, is so much like Cherry that, formerly, many persons considered them identical.

Victoria holds its foliage later than most other varieties and the shoots are seldom attacked by the twig borer *Ægeria tipuliformis*, for which reason, mainly, it is extensively planted for the market.

White Dutch and White Gondoin are much alike, as grown here. They have yet no superior, so far as beauty and mild, rich flavor are concerned, though slightly inferior to certain others in productiveness.

White Grape has a more spreading habit of growth, with slightly larger fruit, and is somewhat more productive, though scarcely equal to the foregoing in quality. It is occasionally planted for commercial purposes.

GOOSEBERRIES—*Ribes*.

Gooseberries, while yet dormant, were sprayed on March 29th with a solution of one pound of copper sulphate in twenty-five gallons of water, as a preventive of mildew.

On May 4th the plat was treated with a spray of three ounces of potassium sulphide, (liver of sulphur) in ten gallons of water. This treatment was repeated weekly, weather permitting, until the fruit was ripe and gathered.

On June 10th owing apparently to unfavorable climatic conditions or possibly, to imperfect spraying, mildew appeared upon the fruit of some of the European varieties. The infected fruit was at once gathered and burned.

The crumpling of the foliage, due apparently to the presence of aphides, has been very rare this year. It usually appears only at the tips of the young twigs, which are cut away and burned, when discovered.

The currant worm, *Nematus ventricosus*, which attacks the foliage of the gooseberry, in common with that of the currant, was also sprayed with a decoction of buhach in water with similarly satisfactory result.

Several varieties, although tabulated, have, for one cause or another, failed to fruit satisfactorily, for which reason, unavoidably, several particulars are not given in the table.

TABULATION OF GOOSEBERRIES, 1897.

Names.	Species.	Planted.	Bloomed.	Ripe.	Weight of berry in ounces.	Productiveness.—Scale 1 to 10.	Quality.—Scale 1 to 10.
Apex	Grossularia ?	1893	May 5	July 25	¼	10	7-8
Auburn	“	1890	“ 10	“ 21	⅓	10	8-9
Bendelon	“	1894	“ 10	“ 19	1-5	10	5-7
Champion	“	1891	“ 10	“ 19	1-17	10	5-6
Chautauqua	“	1892	“ 6	“ 19	¼	10	7-8
Columbus	“	1895	“ 5	“ 24	------	------	6-7
Downing	Oxyacanthoides	1888	“ 6	“ 21	1-7	10	6-7
Golden *Prolific*	Grossularia	1891	“ 12	------	------	------	------
Houghton	Oxyacanthoides	1888	“ 5	July 14	1-16	7	10
Industry	Grossularia	1889	“ 12	------	------	------	------
Keepsake	“	1894	“ 10	July 19	⅓	7	8-9
Lancashire	“	1894	“ 6	“ 19	⅓	10	5-6
Orange	“	1890	“ 5	“ 13	1-10	9	8-9
Pale Red	Oxyacanthoides	1890	“ 5	“ 12	1-22	10	9-10
Pearl	“	1890	“ 5	“ 19	1-6	9	7-10
Red Jacket	“ ?	1890	“ 12	“ 21	1-6	7	7-8
Smith	“	1888	“ 5	“ 14	⅛	7	9-10
Strubler	Cynosbati	1892	“ 5	“ 19	1-6	10	7-8
Tree	“	1892	“ 18	“ 26	1-12	3	5-6
Triumph	Grossularia	1890	“ 10	“ 21	⅓	4	6-7

Apex, a recent seedling from Oregon, has this season, for the first time, produced a fair crop of fruit. It has been understood to be a seedling of the indigenous variety of that region but the habit of growth, and also the size and general character of the fruit, correspond so perfectly with *R. grossularia*, as to warrant the suspicion that it may be an Oregon seedling of that species.

Auburn, Bendelon, Champion, Chautauqua, Columbus, Golden Prolific, Keepsake, Orange, Pearl, Red Jacket and Triumph are understood to be either American seedlings of the European species or possibly hybrids between native and foreign varieties.

Downing and Smith seem to have been very generally accepted as native seedlings, and yet there is more or less ground for suspicion of possible hybridization between the native and the foreign species.

Houghton and Pale Red are among the oldest of the native cultivated varieties, and, so far, are scarcely excelled in either productiveness or quality. Small size is their chief fault.

Strubler and Tree are obviously pure natives. The plants are vigorous and healthy, and the fruit, especially of the former, is of high quality. They are of rather small size, and, so far, only moderately productive.

CHERRIES—*Prunus.*

At the date of blooming there was promise of a bountiful crop of this fruit, but, subsequently, the season proved so specially unfavorable that a very large percentage of the bloom proved abortive.

Putnam scale having been discovered on a few trees, they were sprayed March 31st with kerosene emulsion, consisting of five gallons of kerosene and six pounds of whale oil soap, in forty gallons of water.

Prior to April 15th, growth remaining dormant, the remainder of the cherries were sprayed with a solution of copper sulphate, consisting of one pound of the sulphate in twenty-five gallons of water.

On July 2d and again on the 6th sprayed several cherry trees on which the slug, *Eriocampa cerasi*, had appeared, with kerosene emulsion on the former, and tobacco decoction on the latter date. Both proved effective.

Aphides have proved unusually persistent this season. They appeared on the foliage of a few cherry trees late in September, and were subdued by the use of tobacco water.

In the foregoing tabulation, as well as throughout this report, the numerical estimates upon the scale 1 to 10 are arrived at by comparing varieties of the same *species* only; as, for instance, comparing morellos with morellos, dukes with dukes, and sweet cherries with sweet cherries, ten being the maximum.

These deductions, being based upon the crop of the past unusually unfavorable season, can scarcely be accepted as a trustworthy indication of the comparative value of varieties during other seasons.

TABULATION OF CHERRIES, 1897.

Names.	Species.	Planted.	Bloomed.	Ripe.	Weight of a specimen in ounces.	Productiveness.—Scale 1 to 10.	Quality.—Scale 1 to 10.
Abbesse	Morello	1888	May 8	July 21	1-7	2	5-6
Angouleme	"	1888	" 8	" 26	1-6	2	6-7
Badacconyi	Avium	1894	" 8				
Baendor	Morello	1892	" 8				
Baltavari	Avium	1894	" 8				
Bessarabian	Morello	1888	" 8	Aug. 2			
Brusseler Braune	"	1888	" 10	" 2			
Carnation	Duke	1891	" 8	July 9	1-6	9	7-8
Centennial	Avium	1893	" 7				
Choisy	Duke	1888	" 8		1-6		9-10
Cleveland	Avium	1888	" 7	June 30	1-5	5	7-8
Coe	"	1888	" 8	" 26	1-5	4	4-5
Downer	"	1888	" 8	July 15	1-7	3	5-6
Dwarf Rocky Mountain	Besseyi	1894	" 20				
Dyehouse	Morello	1891	" 8	June 30	1-8	6	5-6
Eagle *Black*	Avium	1888	" 8	July 12	1-7	2	5-6
Early Purple	"	1892	" 6	June 25	1-6	5	4-5
Elton	"	1892	" 8	" 30	1-5	2	4-5
Esperen	Morello	1892	" 8			1	
Eugenie	Duke	1888	" 7	June 30	1-6	2	8-9
Everbearing	"	1892	" 8	" 12	1-6	7	8-9
Florence	Avium	1892	" 8				
Frauendorfer Weichsel	Morello	1888	" 8	June 21	¼	1	6-7
Galopin	"	1891	" 8				
George Glass	"	1888	" 10			1	
German *Kraus*	Avium	1894	" 13				
Griotte du Nord	Morello	1888	" 8	Aug. 2		1	
Hortense	Duke	1888	" 8	July 8	1-5	5	7-8
Ida	Avium	1893	" 8				
King Amarelle	Morello	1891	" 8	July 19	1-8	1	4-5
Knight Early	Avium	1891	" 7			1	
La Maurie	Avium	1893	" 8				
Lancaster	Duke	1894	" 13				
Late Duke	Duke	1890	" 8	July 15	¼	1	7-8
Lithauer Weichsel	Morello	1892	" 8	" 22	1-9	6	4-5
Lutovka	"	1888	" 8			1	
Magnifique	Duke	1888	" 13	July 28	1-6	5	8-9
Mahaleb	Mahaleb	1893	" 8				
Mary *Kirtland*	Avium	1891	" 8	June 30	1-6	7	6-7
Mastodon *Black*	"	1893	" 8				
May Duke	Duke	1888	" 8	June 30	1-7	6	8-9
Mezel	Avium	1891	" 7	" 30	1-7	2	4-5
Minnesota Ostheim	Morello	1892	" 8	July 9	1-8	1	6-7
Modnyansky	Avium	1894	" 8				
Montmorency	Morello	1888	" 10	June 30	1-7	5	4-5
Montmorency Ordinaire	"	1891	" 8	July 22	1-5	9	5-6
Montrueil	Duke	1890	" 8	" 12	1-5	3	8-9
Napoleon	Avium	1892	" 7	" 17	1-7	8	3-4
Northwest	Morello	1893	" 12	" 19	1-7	10	5-6
Ohio *Beauty*	Avium	1891	" 8	June 30	1-6	7	6-7
Olivet	Duke	1890	" 8	July 12	1-5	1	7-8
Orel 25	Morello	1893	" 10				
Orel 27	"	1893	" 10				
Ostheim	"	1891	" 8	July 21		1	3-4
Ostheimer	"	1893	" 8	" 22	1-6	9	4-5
Philippe *Louis*	"	1888	" 8	" 8	1-8	1	7-8
Plymouth *Rock*	Avium	1896					
Purity	"	1893	" 10				
Richmond	Morello	1893	" 8	July 12	1-8	5	4-5
Rockport	Avium	1891	" 7	June 30	1-5	8	6-7

TABULATION OF CHERRIES, 1897.—*Concluded.*

Names.	Species.	Planted.	Bloomed.	Ripe.	Weight of a specimen in ounces.	Productiveness.—Scale 1 to 10.	Quality.—Scale 1 to 10.
Royal Duke	Duke	1891	" 8	June 30	1-8	10	5-6
Rupp	"	1894					
Schmidt	Avium	1894	" 8				
Sebril	"	1896	" 12				
Sklanka	Morello	1888	" 10	July 12	1-7	3	4-5
Spanish Yellow	Avium	1891	" 8	" 14	1-5	3	10
Spate Amarelle	Morello	1888	" 15	" 26	1-6	2	6-7
Strauss Weichsel	"	1888	" 8	" 8	1-6	1	5-6
Suda	"	1893	" 10	" 22	1-6	8	7-8
Tartarian *Black*	Avium	1888	" 8	" 8	1-5	2	6-7
Ulatis, *Cal. Advance*	"	1893	" 6				
Weir 2	Morello	1893	" 12	July 12	1-8	5	4-5
White *Bigarreau*	Avium	1896	"				
Windsor	"	1891	" 8	July 14	1-5	7	4-5
Wood *Governor*	"	1891	" 8	June 30	1-5	2	5-6
Wragg	Morello	1892	" 11	July 22	1-6	7	5-6

MORELLOS.

Abbesse, Angouleme, Bessarabian, Brusseler Braune, Frauendorfer Weichsel, George Glass, Griotte du Nord, Lithauer Weichsel, Lutovka, Orel 25, Orel 27, Ostheim, Ostheimer, Sklanka, Spate Amarelle and Strauss Weichsel are all understood to be importations from northern and eastern Europe, with the hope that more or less of them may prove adapted to the trying climate of our northwestern states. Of these several are vigorous, healthy and very late, strictly culinary fruits; but with one or two exceptions, so far, they are comparatively unproductive, and not relatively promising where the better known varieties succeed.

Baendor, Esperen, Galopin, King Amarelle, Minnesota Ostheim, Northwest, Suda, Weir 2 and Wragg came to us without a history, excepting only the last two, which are known or supposed to be of western origin. So far Weir 2, and possibly Suda, are apparently the most promising of these.

Of the Morellos, Dyehouse, though of very low, spreading habit of growth, with rather small, light-colored fruit, is among the first to ripen and is productive and profitable.

There are ostensibly three Montmorencys in cultivation, but there is so much confusion of names that identity is, so far, quite uncertain. The first of these came as simple Montmorency, and quite possibly may prove to be Large Montmorency. That received as Large Montmorency turns out to be Dyehouse. Trees received as Montmorency Ordinare have now fruited several seasons, but we have not, so far, been able to assuredly determine their correctness.

Philippe *Louis* is large and excellent for culinary purposes, and the tree healthy and vigorous, but, unfortunately, persistently unproductive.

Richmond *Early* has, so far, been the leading cherry for market planting, but recently there are indications that it may find a rival in some one of the Montmorencys.

DUKES.

Carnation, Late Duke, Magnifique, Olivet and Royal Duke, although vigorous, and of generally fair quality, must take second or third rank, so far as productiveness is concerned.

Choisy *Belle de*, is slightly lacking in productiveness, but is second to no other cherry in beautiful appearance and fine flavor.

Eugenie is promising, but requires further trial.

Everbearing, as the name indicates, ripens its fruit in succession during a somewhat lengthened season, and, for this reason, may prove desirable for home use.

Hortense, is one of the largest of the species, and, where hardy, is a desirable market variety.

May Duke is the type, as well as the leading variety of the species; and, where sufficiently hardy, is among the most valuable, as well as profitable for market.

Montrueil is a comparatively recent French variety. It is an early and profuse bearer and, in both tree and fruit, promises well as a commercial variety.

Lancaster and Rupp are perhaps of this species, though too recently planted to satisfactorily indicate their specific status.

HEARTS AND BIGARREAUS.

Badacconyi, Baltavari and Modnyansky are obviously of this species. They were recently imported, in cion, from southeastern Europe, by the national Department of Agriculture. So far, they are vigorous and healthy here, but have not yet matured fruit.

Centennial, Florence, German *Kraus*, La Maurie, Mastodon *Black*, Plymouth *Rock*, Purity, Schmidt, Ulatis (*California Advance*), and White *Bigarreau* are clearly of this species, although none of them have yet fruited sufficiently to warrant a description.

Cleveland, Mary *Kirtland*, Ohio *Beauty*, Rockport and Wood *Governor*, were sent out, years since, by the late Prof. Kirtland of Cleveland, Ohio. Under judicious treatment, in common with this species, they are hardy in southern Michigan.

Coe *Transparent*, is one of the most beautiful and excellent of the species, and worthy of a place in the home plantation.

Downer, and also Eagle *Black*, are unusually hardy, rather late, very productive, and valuable for either the home or market.

Early Purple is specially desirable as the earliest cherry, occasionally ripening with the earliest strawberries.

Elton, Knight *Early*, Mezel, Napoleon, Spanish *Yellow* and Tartarian *Black* are old and generally known varieties, and with two or three exceptions prized as commercial varieties.

Windsor is a quite recent introduction, ripening rather late, and promising well, even as a commercial variety.

Ida, although not yet in bearing, is believed to be of this species.

DWARF ROCKY MOUNTAIN OR SAND CHERRY.

Dwarf Rocky Mountain, *Prunus Besseyi*, has shown fruit here for the past two years. It has even been commended through the public press as well as in nursery catalogues, as of fine flavor. If, however, the plants tested here fairly represent the variety thus praised, the least that can be said of it is, that it is one of the most arrant swindles ever imposed upon the public. The difference betweeen *P. Besseyi* and *P. Pumila* being slight, we may have received the latter by mistake or otherwise.

PRUNUS MAHALEB.

Mahaleb, *European Bird cherry*, is used extensively as a stock on which improved varieties are worked. It has fruited here for two years past. The European name would seem to be appropriate for this country also, since, although it fruited abundantly the past season, we were not able to get even a taste of ripe fruit, but all were taken by birds while yet immature.

PEACHES—*Prunus* or *Amygdalus*.

Doubtless as a result of continuous reproduction and cultivation in different soils and climates, the peach has sported into strains or races, each more especially successful in its accustomed climate or soil.

Of these the Peen-to race is mainly confined to the extreme south, and is followed, as we pass northward, by the Honey race, the Spanish, the Persian, the Oriental Blood, and the North Chinese races.

Among these the Persian race is mainly popular from central Georgia and Texas northward, with, quite recently, an occasional North Chinese variety on trial.

While at the extreme south, these distinctions become important in a choice of varieties to be planted, these races have now become so intermixed or hybridized by cross-fertilization that many such cross-bred varieties are found successful and more or less popular even at the north.

Since, therefore, the question of *race* must depend upon a knowledge of the history of each variety, rather than upon any distinctive peculiarity of either tree or fruit, it seems better that all attempt at such classification be omitted.

The past season, throughout, has been later than usual, and, as heretofore, the pruning has been done while growth was yet dormant, the pruning of peaches having been completed on April 20th.

Completed the early spraying of peaches on April 15th, using one pound of copper sulphate in twenty-five gallons of water. Such spray has, in previous seasons, proved an effectual preventive of leaf curl, *Taphrina deformans;* but, for some unexplained reason, due probably to unusual weather conditions, it failed of the usual effect, the "curl" being very prevalent, alike upon sprayed trees and those not sprayed.

May 17th examined peach trees for *borers*, the larvæ of *Ægeria exitiosa*, finding a few only.

May 19th to 21st, applied a coating of whitewash to the trunks and large branches of peach trees, as a means of preventing a deposit of the eggs of the pin-borer which, during the last two or three years, has proved to be a serious and even fatal enemy of the peach tree in this vicinity. Such application is so far merely experimental, since there are no precedents as guides to the treatment of this insect. The mixture used was milk of lime with a little crude carbolic acid; the whole thickened with hard soap to give it body and tenacity. Experience so far indicates that the application will prove at least partially successful.

May 29th, some of the early varieties of peaches were jarred for curculio, but few were caught, and after a few trials the process was mainly confined to the plums, upon which the attacks were much more persistent.

The Rose Chafer, *Macrodactylus subspinosus*, which in past years has been abundant, has, during the past season, been represented by a very few specimens only, which have been caught in jarring for curculios.

We repeat the suggestion of last year that, as a safeguard against error, a new or unknown variety when sent for trial or identification, should invariably be accompanied by a careful description of both tree (or plant), and fruit, and that the intended name should accompany it, to the exclusion of numbers or of names with numbers attached, the subsequent changing of which is found to be a fruitful source of error, and of the multiplication of vexatious synonyms. Such names, moreover, should be in accordance with the Rules of American Pomology, and with the practice of the National Division of Pomology.

TABULATION OF PEACHES, 1897.

Names.	Planted.	Bloomed.	Flowers—l, large; s, small.	Glands—g, globose; r, reniform; s, serrate.	Ripe.	Adhesion—c, cling; f, free; s, semi-cling.	Weight of specimen in ounces.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.
Adrian	1892	May 6	s	g	Oct. 1	f	5	1	6-7
Advance	1897	------	------	------	------	------	------	------	------
Alberge	1893	May 6	s	r	------	f	------	------	------
Albright	1890	“ 6	s	g	Oct. 4	f	5	1	5-6
Alexander	1892	“ 6	l	g	Aug. 19	s	6	1	5-6
Allen	1890	“ 6	s	r	Oct. 7	f	5	5-6	5
Alpha	1890	“ 7	s	r	Sept. 27	f	------	------	------
Amelia	1890	“ 7	s	r	“ 9	f	4	1	6-7
Amsden	1890	“ 7	l	g	July 31	s	5	2	5-6
Andrews	1890	“ 7	s	r	------	f	------	------	------
Arctic	1894	“ 5	l	r	Oct. 4	f	4	1	3-4
Barber	1893	“ 6	s	r	Sept. 23	f	6	8	6-7
Beers *Smock*	1890	“ 7	s	r	Oct. 8	f	4	1	5
Bell *Favorite*	1890	“ 6	s	g	Sept. 29	f	4	1	4-5
Bequett *Free*	1890	“ 6	s	r	“ 23	f	7	1	5
Berenice	1894	“ 6	l	r	Sept. 24	f	4	1	4
Bickell	1890	“ 6	s	r	Oct. 15	f	4	5	4
Bishop	1890	“ 6	l	g	Aug. 26	f	4	2	8
Blood Leaf	1892	Apr. 30	l	r	Oct. 20	c	3	5	2-3
Bokara	1896	------	------	------	------	------	------	------	------
Bonanza	1890	May 6	s	r	Oct. 15	f	4	1	1-3
Boyle	1890	“ 6	s	g	Sept. 17	f	5	2	7
Brandywine	1890	“ 7	s	g	Oct. 8	f	6	1	5
Brett	1890	“ 7	s	r	“ 31	c	4	1	2-3
Brigdon, *Garfield*	1890	“ 6	s	g	Sept. 13	f	5	1	7-8
Briggs	1890	“ 6	s	g	“ 13	f	5	1	8
Bronson	1894	“ 6	s	r	“ 24	f	4	2	6-7
Brown	1894	“ 5	l	r	Aug. 27	f	3	5	5-6
Burke	1892	“ 6	l	r	Sept. 4	s	6	1	5
California	1895	“ 7	s	r	------	------	------	------	------
Canada	1892	“ 6	l	g	July 31	s	5	1	4-5
Capital	1896	------	------	r	------	f	------	------	------
Chairs	1890	May 6	s	r	Oct. 13	f	5	1	3-4
Champion	1894	“ 6	s	g	Sept. 8	f	6	2	10
Champion (*serrate*)	1890	“ 6	l	s	Aug. 7	s	5	1	5-6
Chili 2	1888	“ 7	s	r	Sept. 23	f	6	1	6-7
Chili 3	1888	“ 6	s	r	“ 24	f	5	1	8
Chinese *Cling*	1890	“ 7	l	r	------	c	------	------	------
Chinese 11741	1896	------	------	------	------	------	------	------	------
Cleffey *Allen*	1892	May 6	s	r	Sept. 24	f	5	4-5	5
Clifton *Cling*	1894	“ 6	s	r	------	c	------	------	------
Columbia	1890	“ 7	l	r	Oct. 8	f	4	1	2-3
Conkling	1890	“ 6	------	------	------	f	------	1	------
Connecticut	1896	“ 7	s	g	Aug. 20	f	------	1	------
Connett	1894	“ 5	l	r	“ 28	f	5	1	7-8
Coolidge *Mammoth*	1892	“ 6	s	g	Sept. 20	f	6	3	7
Corner	1890	“ 7	s	r	“ 23	f	5	3	6
Crane	1890	“ 7	s	r	------	f	------	------	------
Crosby	1892	“ 6	s	r	Sept. 25	f	4	5	7
Crothers	1890	“ 6	s	g	Oct. 4	f	5	1	6-7
Dennis	1890	“ 4	l	g	Sept. 17	f	4	1	5-6
Diamond	1892	“ 6	s	g	Oct. 4	f	5	1	5
Druid Hill	1890	“ 7	s	g	“ 8	f	4	1	8-9
Dumont	1894	“ 7	s	r	Sept. 23	f	4	1	3-4
Dunlap	1892	“ 7	s	g	“ 9	f	5	2	7-8
Dwarf Cuba	1892	“ 6	s	r	------	------	------	------	------
Early Barnard	1888	“ 7	s	r	Sept. 7	f	6	1	5
Early Crawford	1888	“ 7	s	g	“ 8	f	6	1	9-10
Early Crawford 1	1888	“ 7	s	g	“ 6	f	5	1	7-8
Early Crawford 3	1888	“ 7	s	g	“ 6	f	3	1	7

TABULATION OF PEACHES, 1897.—*Continued.*

Names.	Planted.	Bloomed.	Flowers—l, large; s, small.	Glands—g, globose; r, reniform; s, serrate.	Ripe.	Adhesion—c, cling; f, free; s, semi-cling.	Weight of specimen in ounces.	Productiveness—Scale 1 to 10.	Quality — Scale 1 to 10.
Early Michigan 15	1894	May 6	l	g	Sept. 2	f	4	1	9-10
Early Michigan 16	1894	" 4	l	r	Aug. 20	f	5	1	9-10
Early Red	1897								
Ede	1890	May 6	s	g		f			
Elberta	1890	" 6	s	r	Sept. 23	f		1	
Eldred *Cling*	1890	" 6	s	g	Sept. 20	c	5	1	4
Ellison	1889	" 7	s	r	Oct. 7	f	4	3	5-6
Engle *Mammoth*	1892	" 6	s	g	Sept. 13	f	5	2	9-10
Ford *New*	1894	" 6	s	g	" 11	f	4	1	6
Ford *Red*	1894	" 3	s	g	" 13	f	4	1	5-6
Ford 1	1894	" 3	l	r	" 27	f	4	1	6-7
Ford 2	1894	" 6	s	g	Oct. 4	f	4	1	6-7
Ford 3	1894	" 8	s	r	" 30	f	4	1	4
Foster	1894	" 7	s	g	Sept. 2	f	6	1	7-8
Fox	1890	" 7	s	g	Oct. 13	f	3	1	4-5
Geary *Hold On*	1890	" 6	s	r	" 5	f	6	1	5
Gem *Cling*	1890	" 6	s	r		c			
Globe	1888	" 10	s	g	Sept. 24	f	6	1	6
Gold Drop	1890	Apr. 29	l	r	" 30	f	4	2	7-8
Grant *General*	1890	May 6	s	r	" 7	c	5	1	6-7
Great Western	1892	" 6	s	r	Oct. 15	c	4	1	4
Greensboro	1896	" 6	l	g					
Gudgeon	1890	" 6	s	r	Oct. 15	f	5	1	5-6
Haas	1890	" 6	l	r	Aug. 18	f	5	1	5-6
Hale	1888	" 8	l	g	" 25	s	6	1	5
Hale Oblong	1888	" 7	l	g	" 9	s	5	4	6-7
Hance Golden	1890	" 7	s	g	Sept. 13	f	5	1	8-9
Hance Smock	1890	" 6	s	r	Oct. 8	f	5	1	5
Heath *Cling*	1890	" 7	s	r		c			
H. No. 34	1890					f			
Hinman?	1892	" 6	l	r	Sept. 27	f	6	3	7
Hughes IXL	1892	" 6	l	r	Nov.	c	2	1	1-2
Husted 101	1895	" 6	s	r	Sept. 20	f	3	1	3-4
Husted 130	1895	" 6	s	r	" 18	f	3	1	6-7
Husted 700	1895	" 6	l	g	Aug. 18	f	4	1	7-8
Hyatt	1888	" 7	l	g	" 16	s	5	1	5-6
Hynes	1890	" 7	l	g	" 18	s	5	1	5
Hyslop	1892	" 6	s	r	Oct. 7	c	4	1	4
Ice Mountain	1894	" 6	l	r	Nov.	f	1	4	1
Infant Wonder	1892	" 3	s	g	Sept. 6	f	5	8	8-9
Iron Mountain	1895	" 7	s	r	Oct. 13	f	7	1	?
Jacques Late	1890	" 3	s	g	Sept. 25	f	5	2	5-6
Japan Dwarf	1894	Apr. 29	l	r	Aug. 10	f	3		5-6
Jersey Yellow	1895	May 6	s	r	Oct. 15	f	3	1	4-5?
Jones	1892	" 6	s	g	Sept. 24	s	7	1	4-5
June Rose	1894	" 6	l	g	" 6	f	5	1	6-7
Juno	1894	" 6	l	r		f			
Kalamazoo	1890	" 6	s	r	Sept. 20	f	4	3	7-8
Kallola	1892	" 4	l	r	" 17	f	5	8	3-4
Kraus 4	1895								
Kraus 16	1895								
La Fayette	1897								
La Fleur	1895	May 4	l	r	Oct. 5	f	3	1	2-3
Lancaster	1894			g					
Late Barnard	1894	May 7	s	r	Sept. 27	f	5	5	6-7
Late White	1889	" 7	s	r	Oct. 4	f	6	1	5
Lemon *Free*	1894	" 6	l	r	" 8	f	5	5	4
Lewis	1890	" 6	l	r	Aug. 26	f	4	5	6-7
Lock *Cling*	1892	" 7	s	r	Oct.	c		1	
Longhurst	1894	" 6	l	g	Sept. 27	f	6	1	5-6

TABULATION OF PEACHES, 1897.—*Continued.*

Names.	Planted.	Bloomed.	Flowers—l, large; s, small.	Glands—g, globose; r, reniform; s, serrate.	Ripe.	Adhesion—c, cling; f, free; s, semi-cling.	Weight of specimen in ounces.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.
Lorentz	1895	May 6	s	r	Oct. 15	f	3	1	5-6
Lovell	1892	April 29	s	g	Sept 30	f	4	1	7-8
Lovett White	1890	May 7	s	r	" 30	f	5	2	6-7
Magdala	1890	" 7	s	r	" 8	f	5	1	8-9
Marshall	1890	" 7	s	r	Oct. 5	f	4	1	5-6
McCollister	1890	" 6	s	r	" 2	f	6	4	6
McKevitt *Cling*	1892	" 7	s	g	" 4	c	6	1	3-4
Milhizer	1892	" 7	s	g	" 15	f	4	1	5
Minnie	1890	" 7	s	r	Sept. 9	f	5	1	5-6
Moore	1890	" 7	s	g	---------	f	------	------	------
Morris County	1888	" 7	s	r	Sept. 2	f	3	1	3-4
Morris White	1888	" 10	s	r	" 22	f	5	1	9
Mountain Rose	1888	" 7	s	g	" 1	f	4	1	8
Muir	1890	" 7	s	r	" 25	f	6	1	6-7
Murat	1889	" 7	s	r	Oct. 8	f	8	1	4-5
Mystery	1888	" 7	s	r	Sept. 2	f	5	1	8
North American Apricot	1892	" 6	l	r	---------	f	------	2	5-6
Nectarine	1888	" 6	l	r	---------	f	------	------	------
Need	1890	" 7	s	r	Sept. 7	f	4	1	5
Neil *Marshall*	1892	April 29	l	r	Oct. 15	f	3	2	4-5
Newington *Free*	1893	May 7	s	r	" 6	f	4	1	6
New Prolific	1894	" 6	s	g	Sept. 6	f	5	1	7
Normand	1892	" 7	s	r	Oct. 15	f	4	1	5
Oldmixon *Cling*	1888	" 7	s	g	Sept. 26	c	6	1	5
Oldmixon *Free*	1894	" 6	s	g	" 23	f	5	1	9-10
Oriole	1894	" 4	l	r	" 27	s	4	4	4
Ostrander	1892	" 7	s	g	" 2	f	4	1	5-6
Pallas	1894	" 6	l	g	" 17	f	------	1	------
Palmerston	1890	" 8	l	g	Oct. 5	s	7	1	7
Pansy	1890	" 8	s	r	---------	f	------	------	------
Pearl	1889	" 6	s	g	Sept. 20	f	5	1	7
Peninsular *Yellow*	1894	" 6	s	g	" 24	f	5	1	5
Pickett	1890	" 7	s	r	Oct. 5	c	4	4	5-6
Pratt	1890	" 7	s	r	Sept. 8	f	------	1	------
Prince R. R.	1890	" 7	s	g	" 20	f	4	1	7-8
Princess	1894	" 6	l	g	Oct. 6	f	4	1	8-9
Princess *Wales*	1889	" 7	l	g	Sept. 28	f	------	1	------
Prize	1892	" 6	s	g	" 28	f	6	3-4	5-6
Prize 1	1890	" 7	s	r	Oct. 2	f	4	1	6
Red Cheek *Melocoton*	1893	" 6	s	g	" 4	f	5	1	5
Red Seedling	1893	" 6	l	g	Aug. 31	s	4	2	6
Reeves *Favorite*	1890	" 7	s	g	Sept. 20	f	4	1	6 7
Reid	1890	" 6	s	g	" 6	f	5	1	7-8
Ringgold	1890	" 7	s	r	Oct. 15	c	4	1	6-7
River Bank	1892	" 7	l	r	Aug. 2	s	5	2	5
Rivers	1888	" 6	l	r	" 10	f	5	5	6 8
Robena	1894	------	------	r	---------	------	------	------	------
Roser	1892	May 3	l	r	Oct. 13	f	4	2	2-3
Roseville	1892	" 7	l	g	" 4	c	6	1	6
R. S. Stevens	1891	" 3	s	r	Sept. 9	f	4	4-5	6
Salway	1890	" 6	s	r	Oct. 20	f	5	9	6
Scott	1890	" 6	s	r	" 4	f	5	2	7
Sener	1888	" 10	s	r	---------	f	------	------	------
Shipley	1890	" 7	s	g	Sept. 24	f	5	1	4-5
Smock *Free*	1888	" 7	s	r	Oct. 15	f	5	1	5-6
Smock	1892	" 6	s	r	" 8	f	6	2	5 6
Sneed	1896	" 4	l	r?	---------	------	------	------	------
Snow *Late*	1890	" 7	s	r	Sept. 7	f	5	2	5-6
Southern Early	1890	" 6	s	r	" 7	f	------	1	------
Spottswood	1894	" 7	l	r	" 18	f	4	1	6-7

TABULATION OF PEACHES, 1897.—*Concluded.*

Names.	Planted.	Bloomed.	Flowers—l, large; s, small.	Glands—g, globose; r, reniform; s, serrate.	Ripe.	Adhesion—c, cling; f, free; s, semi-cling.	Weight of specimen in ounces.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.
Stark Heath	1892	May 6	s	r	Oct. 15	c	4	1	3
Steadley	1888	" 10	s	r	Sept. 2	f	4	1	7–8
Stevens Late	1890	" 7	s	r	Oct. 15	f	4	1	5–6
Stevens *Rareripe*	1892	" 7	s	r	" 2	f	5	3	7
St. John	1890	" 6	s	g	Aug. 26	f	4	1	7–8
Strong *Mammoth*	1892	April 30	s	g	Sept. 20	f	5	1	6
Stump *World*	1890	May 3	s	g	Aug. 31	f	4	4	6
Summer Snow	1894	" 6	l	g	Oct. 4	c	3	1	4–5
Surpasse *Melocoton*	1890	" 7	s	r	Sept. 6	f	4	1	8
Switzerland	1890	" 6	s	g	" 27	f	4	1	5-6
Tallman 1	1894	------	------	r	------	f	------	------	------
Tallman 2	1894	------	------	g?	------	f	------	------	------
Tallman 3	1894	May 6	s?	g	------	f	------	------	------
Toledo	1894	" 7	l	g	Aug. 26	f	4	1	6
Toquin	1892	" 7	l	r	Sept 25	f	4	5	7
Townsend	1892	" 6	s	g	" 30	f	6	1	5–6
Triumph	1896	------	------	g	------	f	------	------	------
Troth	1890	May 6	s	g	Sept. 4	f	5	2	5–6
Tuskena	1892	" 6	s	r	Oct. 4	c	6	1	8–9
Wager	1890	" 6	------	r	" 2	f	4	4	4–5
Walker	1892	" 6	s	g	------	f	------	1	------
Walker Var.	1893	" 6	s	g	Oct. 4	f	4	1	7–8
Washington	1890	" 6	s	g	Sept. 23	f	6	1	6–7
Willett	1894	" 6	l	r	" 30	f	4	1	5–6
Williamson	1892	" 6	s	g	" 29	f	6	1	5–6
Wonderful	1890	" 6	s	r	Oct. 4	f	6	2	5
Worthen	1890	" 7	s	r	Sept. 6	f	6	1	8
Yellow Rareripe	1888	" 7	s	g	" 18	f	4	1	3–4
Yenshi *Hardy*	1896	" 7	l	r	------	------	------	1	------
York Pearl	1896	------	s	------	------	------	------	------	------
Zea	1897	------	------	------	------	------	------	------	------

As the natural result of overproduction last year, the set of peaches the present year has been very light. This result has doubtless been emphasized as the consequence of unusually unfavorable weather during the season of blooming, and the prevalence of leaf curl during the setting of the fruit.

Under such conditions the result, as shown in the foregoing tabulation, should be accepted as a more or less uncertain indication of the ability of the varieties to withstand unfavorable influence rather than a trustworthy evidence of their comparative value under average conditions.

Of those tabulated, Advance, Early Red, La Fayette and Zea are recent seedlings originated by C. Engle of Paw Paw, Michigan, and first planted here in April last.

Of the fourteen varieties ranking in productiveness, as high as five in the scale one to ten, only one, received from Missouri as Infant Wonder, grades as high as eight to nine in quality.

Toquin, a recent Michigan variety, from the town of that name, grades as high as seven in quality.

Barber, an Allegan county seedling; Late Barnard, origin unknown; Lewis, from Allegan county, and Rivers, originating in England, range from six to seven.

Brown, of Berrien county, Michigan; R. S. Stevens, from Western New York, and Salway, of England, grade at six.

Allen and Cleffey *Allen*, place of origin not known, at five.

Bickell, Southern Early, Crosby (from Massachusetts) and Lemon *Free*, origin not known, rank as low as four to five in quality.

Blood Leaf, though productive, is valueless so far as the fruit is concerned, though a curiosity, on account of the dark brownish red color of its foliage.

Arctic and Bokara are on trial with the hope that they may prove unusually hardy and hence better adapted to northern latitudes.

Crane was received, under this name, from Allegan county, but with the understanding that it was identical with St. John. It proves to be a fair yellow peach, though much later than the true St. John.

Crosby has produced far more than the average of this year, with the quality somewhat above medium, while the weight of a specimen is slightly under the average.

Elberta has this year fruited very sparsely. It is reputed generally, to be specially liable to leaf curl. Experience so far would seem to warrant the suspicion that it may fail to permanently maintain its present popularity in our northern climate.

Hinman, as received here, was for a time understood to be identical with Barber. It, however, proves to be distinct, so far as trial trees received here are concerned. Whether or not this is an old variety renamed is yet to be determined.

Hyatt, Hynes, Infant Wonder, Jones, Red Seedling and River Bank are semi-clings of the Hale-Amsden type, differing but slightly, save in season of ripening.

Ice Mountain and Iron Mountain may probably be desirable in a more southern latitude, though so late as to be worthless here. Brett, *Mrs.*, identity doubtful, as received here, is as late as the foregoing, although said to be prized at Newburg, N. Y., where it originated. Strangely enough Downing (Appendix, page 143) gives the leaf glands as both globose and reniform.

June Rose is said to be more recently renamed Superb, by what authority we are not informed.

McCollister still maintains its status for quality, and is confidently commended as the most promising yellow market peach for middle and late September.

Minnie, received from Texas in 1890, ripens here in ordinary seasons early in August, and is of more than medium quality. Another of this name, coming from an unknown source, through the Agricultural College, ripening in late September in ordinary seasons, is of lower quality and less productive.

Sneed and Triumph come to us from the south with high recommendation, but have not yet fruited here. Their alleged earliness may prove less important at the north, since they must compete in the market with the later varieties of the south.

Tallman 1, 2 and 3 come to us as Lenawee county seedlings. Fruit of No. 1 sent for examination was of very high quality and apparently of special value as a variety for the home.

Wager has been received from several sources, but so far we are far from certain that any of them are true to name. The variety is reputed to reproduce itself from the pit. This assumption, if but partially true, may account for the above result.

Worthen *Jennie*, which comes from Texas, proves to be of superior quality here.

GRAPES.—*Vitis.*

The past season has been scarcely as favorable as usual for this fruit, and while all have matured later than usual, several of the later and less hardy varieties have scarcely reached their full color and flavor.

On April 12 to 15 one pound of copper sulphate in 25 gallons of water was applied.

On August 23, mildew having appeared upon a few plants, they were sprayed with a solution of one pound of copper sulphate in 250 gallons of water.

The season throughout, having been unusually dry in this immediate locality, grapes have been quite generally exempt from the attacks of fungi.

The only troublesome insect observed this season is the black aphis, which attacks the tips of the growing canes. In some cases the affected tips have been cut away and burned, while in others they have been subdued by applying a strong decoction of tobacco stems.

The stakes upon which the vines in the southwest block have heretofore been trained have now been replaced by a two-wire trellis, upon which the plants are being trained, on what is commonly known as the Kniffin system.

The unusual exemption from frost, with mild weather and slight rains, till past the middle of November, has resulted in the very general retention of foliage till near the present time (November 24), so that the pruning of grapes, which is usually done in autumn, is yet in progress.

For convenience in consulting and comparing varieties, grapes are arranged alphabetically in a single table, and their species, or parentage, given in a column devoted to that purpose.

In such column the known, or inferred, species of the seed parent is first given; and, in case of actual or inferred hybridization, the species of the actual or supposed pollenating parent is appended with an x.

The usual abbreviations of specific names are employed in such column.

Tabulation of Grapes—Vitis—1897.

Abbreviations—Bunch: c, compact; cy, cylindrical; l, large; o, open; r, roundish; s, shouldered. Berry—Form: l, large; m, medium; o, oval or ovate; r, round; s, small. Color: a, amber; b. black; g. greenish; p, purplish; r, reddish; w, whitish; y, yellowish.

No.	Names.	Species.	Bloomed.	Ripe.	Received from.	Vigor—Scale 1 to 10.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.	Bunch.		Berry.		
									Form.	Weight in ounces.	Form.	Size.	Color.
1	Adirondac	Lab. x Vin.	June 29	m Sept.	Ell. & Barry	6	1	4-5	l c s		r	5-8	b
2	Agawam	Lab. x Vin.	" 30	m Oct.	Hubbard	8-9	3-4	6-7	l o s	5	r	8-9	p b
3	Alice	Lab			T. J. Dwyer								
4	Aminia	Lab. x Vin.	June 28	b Oct.	Hubbard	10	5	7-8	l s		r	7-8	b
5	August Giant	(Vul. x Lin.) x Vin.	" 29	b Oct.	Hubbard	10	1	5	l s		r	6-7	r b
6	Barry	Lab. x Vin.	" 26	e Sept.	Hubbard	9-10	1	7	r c s	4	r	8-9	b
7	Beagle	(Rip. x Lab.) x Lab.			Munson								
8	Bell	Vul. x (Bour. x Lab.) ?	June 24	e Sept.	Munson	10	10	8	cy r	4	r	8 9	
9	Belvidere	Lab.	" 28	m Sept.	Ag. Col.	8 9	5	4-5	c s	5	r	5-6	b
10	Berckmans	Vul. x (Bour. x Lab.)	" 24	m Oct.	Ag. Col.	10	2	8-9	l s	4	r	5-6	r
11	Berlin	Lab.	" 30	b Oct.	Hosford	7	3	5-6			r	5-6	g w
12	Black Eagle	Lab. x Vin.	" 26	e Sept.	Hubbard	7	5	6-7	l c s	4	r	6-7	b
13	Black Pearl	Vul. x Lab.	" 20	e Sept.	Ag. Col.	10	1	3-4	cy s	2	r	4-5	b
14	Blanco	(Rip. x Lab.) x (Lab. x Vin.)	" 30	m e Sept.	Munson	9	1	6	cy s	4	r	5-6	w
15	Brighton	Lab. x Vin.	July 2	e Sept.	Hubbard	8-10	8	10	l s	6	r	5-6	r
16	Brilliant	Lab. x Vin.	June 30	m Sept.	Munson								r
17	Burnet	Lab. x Vin.	" 30	m e Sept.	Ell. & Barry	8	8	7	c s	4	r	4 5	b
18	Cambridge	Lab.	" 29	e Sept.	Barnhart	8	3		cy s		r	6-7	b
19	Campbell Early	Lab. x Vin.			Josselyn							10	b
20	Catawba	Lab. x Vin.	June 29	e Oct.	Hubbard	8	4	8-9	l s	3	r	6-7	r
21	Caywood, 50	Lab	July 2	m e Sept.	Caywood	10	2	3-4	l	6	r	5-6	
22	Centennial	Lab. x Vin.	June 30	m Oct.	Campbell	5	10	10	cy s	3	r	3-4	w
23	Challenge	Lab. x Vin.	" 29		Barnhart								
24	Champion	Lab.	" 24	b Sept.	Hubbard	10	8	3	c s		r	4-5	b
25	Chidester, 3	Lab.	" 30	m e Sept.	Chidester	8	1	9	r s		r	3-4	r
26	Chidester, 4	Lab.	" 29	e Sept.	Chidester	9	1	7-8	r	3	r	4-7	r
27	Clark				Div. Pom.								
28	Clevener	Vul. x Lab.	June 30		Barnhart	10	1	4	cy	3	r	4-8	b
29	Clinton	Vul. x Lab.	" 28	b Oct.	Hubbard	10	7	4	cy s	3	r	3-5	b
30	Colerain	Lab.	" 30	m e Sept.	Farmer	10	5	8 9	c	6	r	5-7	l g
31	Columbia	Vul. x Lab.	" 28	m Oct.	E. & B.	7	7	5	l	3	o	6-7	a
32	Columbian	Lab.	" 30	b Oct.	Farmer	10	1	4	l ?		r	10	p
33	Concord	Lab.	" 30	b Oct.	Home	8-10	5-8	5 6	cy s	7	r	5-6	b

34	Cortland	Lab.	" 28	m Sept.	Lambert	10	1	2-3	o s	3	r	5-6	b
35	Cottage	Lab.	" 28	b Oct.	Hubbard	7	4-5	4-5	cy	4	r	4-7	b
36	Creveling	Lab. x Vin.	" 30	e Sept.	Hubbard	10	3	8-9	l		r		b
37	Delaware	Bour. x Lab. ?	" 28	b Oct.	Hubbard	5-6	8-9	10	c cy's	3	r	2-3	r
38	Diamond	Lab. x Vin.	" 29	m e Sept.	Chase	8	2	7-8	l c s	6	r	5-6	w
39	Diana	Lab. x Vin.	" 28	m Oct.	Hubbard	10	1	7-8	c cy	4	r	5-6	r
40	Downing	Æst. x Vin.	" 26	m Oct.	Hubbard	4-5	8	8-9	l c s	11	o	7-8	b
41	Dracut	Lab.	July 1	e Sept.	Hubbard	10	1	2-3	cy s		r	6-8	a
42	Duchess	Lab. x Vin.	June 30	m Oct.	Hubbard	8-9	1	7	l s	6	r	3-4	g
43	Early Golden	Lab. x Vin.			Munson								
44	Early Market	Lab. x Vul.			Munson								
45	Early Victor	Lab. x (Bour. x Lab.)	June 28	m e Sept.	Hubbard	10	10	7-8	c s	3	r	4-5	b
46	Eaton	Lab.	" 26	e Sept.	Hubbard	10	5	4	l s	8	r	7-9	b
47	Elaine	Lab. x Vin.	" 30	m e Sept.	Engle	9	1	7-8	l		r	6-7	r
48	El Dorado	Lab. x Vin.	" 30		Hubbard	7							
49	Elvira	Lab. x Vul.	" 30	m Oct.	Hubbard	10	5	4-5	cy	4	r	5-7	w
50	Empire State	Lab. x Vin.	" 30	m Oct.	Hubbard	10	8	8-9	cy s	6	r	3-4	w
51	Essex	Lab. x Vin.	" 29	m Oct.	Hubbard	8-9	2	6 7	c s	3	o	5-8	r
52	Esther	Lab. x Vin.	" 28	b Oct.	Josselyn	8-9	1	6	cy		r	6-7	w
53	Etta	Lab. x Vul.	" 30	m Oct.	Hubbard	10	5	4 5	c s	7	r	6-8	w
54	Eugenie	Lab.	" 29		Ell. & Barry	7			l o		r		
55	Eumelan	Lab. x Vin.	" 28	b Oct.	Hubbard	10	7	8	l s	5	r	5-6	b
56	Eva	Lab.	" 24	b Oct.	Hubbard	7	1	5	c s	2	r	5-6	w
57	Excelsior	Lab. x Vin.											
58	Faith	Lab. x Vul.	June 30	m Sept.	Ag. Col.	8-9	1	7-8	cy l s	1	r	4 5	l a
59	Gærtner	Lab. x Vin.	" 28	m Oct.	Hubbard	10	1	5-6			r	6-7	r
60	Geneva	Lab. x Vin.	" 29	m Oct.	Chase	9	3	8-9	l c	2	o	6-7	w
61	Gœthe	Lab. x Vin.	" 30		Hubbard	7			cy s		o	10	y g
62	Golden Drop	(Lab. x Vin.) x (Bour. x Lab.)	" 28	m e Sept.	Hubbard	5	8	9-10	cy s	2	r	3-4	w
63	Golden Gem	(Bour. x Lab.) x Vin.	" 30	b Oct.	Campbell	6	5	10	cy s	2	r	2	w
64	Goldstein	?		Early	Thompson	10			large			large	
65	Guinevra	Lab. x Vin.	June 28	e Sept.	Engle	10	6	6-7	cy c	4	o	6 8	w
66	Hall	Lab.	" 30	b Oct.	Hall	10	5	6-7	c s	4	r	5-7	b
67	Hartford	Lab.	" 28	e Sept.	Hubbard	6-7	1	3-4	l c s	6	r	5-6	b
68	Hayes	Lab.	July 2	m e Sept.	Hubbard	10	1	6-7	cy s	4	r	3-4	w
69	Herbert	Lab. x Vin.	June 29	e Sept.	Hubbard	10	1	6 7	cy s	4	r	6-8	b
70	Honey	Lab. x Vin.	" 30	b Oct.	Engle	8	1	7-8	cy s	4	r	6-7	w
71	Hosford	Lab.	" 30	m e Sept.	Hosford	8	6	5-6	cy s	6	r	9-10	b
72	Iona	Lab. x Vin.	July 2	m Oct.	Hubbard	8-9	9	10	l s	5	o	5-6	r
73	Iris	Lab. x Vin.	" 1	b Oct.	Engle	10	1	5-6	r s		r	6-7	r
74	Isabella	Lab. x Vin. ?	June 26	m e Oct.	Hubbard	10	7	8	l s	4	o	6-7	b
75	Ives	Lab.	" 29	e Sept.	Hubbard	8	10	3-4	cy s	5	r	4-5	b
76	Janesville	Lab.	" 28	e Sept.	Hubbard	10	8	4	r cy s	4	r	5-6	b
77	Jefferson	Lab. x Vin.	July 1	b Oct.	Hubbard	8-9	10	8-9	r cy s	8	r	5-6	r
78	Jessica	Bour. x Lab.	June 26	m Sept.	Smith	8-9	8	6	cy s	4	r	4-5	w
79	Jewell	Bour. x Lab.	" 30	m Sept.	Stayman	7	1	6-7	s	3	r	3-4	b

Tabulation of Grapes, 1897—Concluded.

No.	Names.	Species.	Bloomed.	Ripe.	Received from.	Vigor—Scale 1 to 10.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.	Bunch.		Berry.		
									Form.	Weight in ounces.	Form.	Size.	Color.
80	Josselyn 5, 2, 1		June 29	b m Oct.	Josselyn	10	5	8-9	cy s	4	r	5-6	w
81	Josselyn 7, 2, 1		July 2	m Oct.	Josselyn	10	8	10	cy s	6	r	6-7	w
82	Josselyn 9, 2, 1		June 29	m Oct.	Josselyn	9	1	5-6	cy c	4	r	6 8	b
83	Josselyn 10, 2, 1		July 2		Josselyn	8							
84	Lady	Lab.	June 28	m Sept.	Josselyn	8	9	6	cy	4	r	6-7	w
85	Leader	Lab.	" 29	b Oct.	Josselyn	6	1	5-6	cy o		r	5-6	w
86	Leavenworth	Lab.	" 28	b Oct.	Stayman	10	1	6-7	c s	4	r	6-7	b
87	Lindley	Lab. x Vin.	" 29	e Sept.	Hubbard	9	2	6-7	l s	4	r	5-7	r
88	Lutie	Lab.	" 30	m e Sept.	Parry	9	5	2-3	r	4	r	2-3	r
89	Lyon		" 29	b Oct.	Chidester	10	8	8-9	cy	4	r	7-8	w
90	Mason, *Mrs.*	Lab. x Vin. ?	July 1	e Sept.	Mason	10	1	6-7	r		r	5-6	r
91	Massasoit	Lab. x Vin.	June 28	e Sept.	Hubbard	8	4-5	6-7	r s	4	r	6-8	r
92	Merrimac	Lab. x Vin.	" 30	e Sept.	Hubbard	8-9	2-3	7	cy	6	r	8-9	b
93	Michigan	Lab. x Vin.	" 30	m e Sept.	Engle	10	1	7-8	r cy	3	r	5-6	g w
94	Millington	Lab.	" 29	e Sept.	Palmer	6	1	5	cy c	5	r	7-8	b
95	Mills	Lab. x Vin.	July 1	b m Oct.	Ell. & Barry	8-9	5	10	l cy s	8	r	5-6	b
96	Minnesota	Lab. ?	June 29	m Oct.	Graham	10	1	4-5			r	5-6	w
97	Monroe	(Bour. x Lab.) x Lab.	" 28	m Oct.	E. & B.	10	8	6	l s	4	r	6-7	b
98	Moore Early	Lab.	" 29	m Sept.	Hubbard	9-10	3	5	c s	7	r	7-8	b
99	Moyer	Bour. x Lab.?	" 28	m Sept.	Hubbard	7-8	1	4-5	cy s	3	r	3-4	a
100	Naomi	(Lab. x Vul.) x Vin.	" 22		Hubbard	10	1		l cy s		r o	5-6	l g r
101	Nectar	Lab. x (Bour. x Lab.)	July 1		Caywood	10			cy s		r		b
102	Niagara	Lab.	" 2	b m Oct.	Hubbard	10	1	5-6	c s	7	r	7-8	w
103	Northern Light	Lab.	" 1	b Oct.	Bucke	5-6	1	7-8	cy c s		r	4-5	w
104	Olita	Lab. x Vin.	" 1	b Oct.	Engle	5	2	6	cy c	3	r	4-5	g w
105	Oneida	Lab. x Vin.	June 28		Hubbard	7			o c		r	7-8	r
106	Osage	Lab.	" 28	b Oct.	Stayman	8	1	5	o		r	7-8	b
107	Owosso	Lab.	" 30	e Sept.	Ell. & Barry	10	4	4-5	r cy s	4	r	6-7	p r
108	Ozark	Æst.	July 4	m Oct.	Stayman	10	5	4-5	cy	6	r	5 6	b
109	Peabody	Vul.	June 30	m e Sept.	Campbell	8	8	5-6	l cy	4	r	5-6	b
110	Perkins	Lab.	" 28	b Oct.	Hubbard	10	5	2	c cy s	2	r	6-7	r
111	Pocklington	Lab.	" 30	m Oct.	Hubbard	8	8	6-7	cy s	7	r	7-8	y
112	Poughkeepsie	Bour. x Lab.	" 28	m Oct.	Hubbard	2-3	10	9-10	cy c s	3	r	4-5	r
113	Prentiss	Lab. x Vin.	" 30	m Oct.	Hubbard	10	10	7-8	cy c	4	r	6-7	w
114	Presley	(Lab. x Vul.) x Lab.	" 24	e Sept.	Munson	9	10	4-5	cy c s	3	r	4-5	r

115	Progress (Norfolk?)	Lab. x Vin.	" 30	e Sept.	Stayman	10	3	4-5	r c	3	r	5 6	b
116	Pulpless	Lab. x Vin.	July 1		Engle	9			l s		o	8-9	b
117	Rentz	Lab.	June 26	e Sept.	Hubbard	10	5	3-4	c s		r	5-6	b
118	Requa	Lab. x Vin.	" 28	e Sept.	Campbell	8 9	5	7-8	cy s	6	r	6-7	r
119	Rochester	Lab. x Vin.	" 28	m e Sept.	Ell. & Barry	7-8	4-5	6-7	cy c s	7	r	4-5	r p
120	Rockwood	Lab.	" 30	e Sept.	Josselyn	6	1	7-8	l c s	4	r	3-6	b
121	Rogers 5	Lab. x Vin.	" 28	e Sept.	Hubbard	9	5	7	r c		r	5-7	r
122	Rogers 8 ?	Lab. x Vin.	" 29		Hubbard	10			r c		o		
123	Rogers 24	Lab. x Vin.	" 24	e Sept.	Hubbard	10	6	6-7	c s	6	r	6 7	r
124	Rogers 30	Lab. x Vin.	" 30	b Oct.	Hubbard	10	1	5	o s	3	r	7-8	r
125	Rommel	(Lab. x Vul.) x Vin.	" 30		Munson	8-9			o s		r		g w
126	Salem	Lab. x Vin.	" 30	e Sept.	Hubbard	10	2	5-6	o s	4	r	10	d r
127	Secretary	(Lab. x Vul.) x Vin.	" 28	m Oct.	Ell. & Barry	5	10	8	c s	4	r	4-5	b
128	Telegraph	Lab.	" 30	m Sept.	Hubbard	7	8	5	c s	9	r	6-7	b
129	Themis (incorrect)	Lab. x Vin.	July 2	e Sept.	Engle	9	7	5-6	o s	5	r	6-7	b
130	Triumph	Lab. x Vin.	" 2	Nov.	Campbell	10	7	8-9	l c s	11	r	4-5	g y
131	Ulster	Lab. x Vin.	June 24	m Oct.	Caywood	5-6	9-10	9-10	cy c	5	r	6-7	r
132	Vergennes	Lab.	" 26	e Sept.	Hubbard	7-8	8-9	8-9	l c s	5	r	7-8	r
133	Vesta	Lab. x Vin.	" 29		Engle	9	1	5-6				7-8	w
134	Victoria (black)	Lab.			Josselyn	10	2	6	cy s	5	r	5-6	b
135	Victoria (white)	Lab.	" 30	e Sept.	Campbell	7	1	7	cy s		r o	5-8	w
136	Warder	Lab.	" 30	e Sept.	Huber	5	1	5			r	6-7	b
137	Washington, *Lady*	Lab. x Vin.	July 2	m Oct.	Hubbard	7	1	7	l c s	7	r	5-6	l y
138	Wells ?	Lab.	June 29	b Oct.	Robards	9	5	9		3	o		w
139	White Ann Arbor	Lab.	July 1		Scott	7		5	c		r		w
140	White Beauty	Lab. x Vin. ?	June 29	b Oct.	Stayman	8	4	8	cy o		r	4-5	w
141	White Imperial	Lab. x Vin. ?	" 29	b Oct.	Stayman	8	1	7-8	cy l s	2	r	5-6	w
142	Wilder	Lab. x Vin.	" 28	m Oct.	Hubbard	7-8	2	7-8	c s		r	8-9	b
143	Willis	Bour. x Lab. ?	" 28	m Sept.	Campbell	10	1	5-6	c s	5	r	5 6	r
144	Winchell	Lab. x Vin.	" 29	b Sept.	Ell. & Barry	10	8	8-9	l c s	5	r	5 6	w
145	Witt	Lab. x Vin.	" 30	b Oct.	Campbell	10	4	7-8	c s		r	5-9	w
146	Woodruff	Lab. x Vin.	" 24	m Oct.	Scott	8-9	5	4-5	r s	4	r	7 8	r
147	Worden	Lab.	" 26	m e Sept.	Hubbard	10	3	7-8	l s	6	r	7-8	b
148	Wyoming	Lab.	" 30	m e Sept.	Hubbard	8-9	2	4	l s	3	r	5-6	r

Of many varieties, plants of fruiting age have proved unproductive during the past season; a result perhaps due, in whole or in part, to unseasonably cold winds from Lake Michigan during the blossoming season.

Unseasonably cool weather also occurred during the season of ripening, which was from two to three weeks later than usual. Owing apparently to these facts, certain varieties have failed to fully develop their usual quality.

Adirondac originated at the foot of the Adirondac mountains, near Lake Champlain. It was first brought to notice by the exhibit of beautiful, ripe, luscious clusters at a meeting of the American Pomological Society, at Boston, and a report of the committee on native fruits commended it very highly, but away from its original locality it has generally proved a decided failure.

Agawam, alphabetically, leads the entire list of the Rogers' hybrids, of which seventeen appear in the foregoing tables. While they afford a surprisingly high average result of a single set of pollenations of *vinifera* upon our wild *labrusca*, it is doubtful if any of them possess qualities which will insure their permanent popularity. With these, as well as (with rare exceptions) with all hybrids with *vinifera*, the increased liability to mildew in many if not most American climates, demands more careful and thorough preventive treatment than most cultivators are accustomed to bestow.

To this as to most general rules, experience here would indicate occasional exceptions. Among such we especially note the Downing, which, although in foliage and habit of growth giving decided evidence of *vinifera* parentage, has proved healthy and productive, of very large clusters, of superior quality, often keeping in good condition till March, with only ordinary care. Much the same may also be said of Jefferson and Mills.

Brighton, though slightly liable to mildew, is so admirable in quality as to richly deserve a place in the home plantation. It needs the proximity of some other variety as a fertilizer.

Delaware is, by many experts, believed to be partially of *vinifera* parentage. Here it has proved healthy and productive, although experience elsewhere would indicate that it may be fastidious as to soils or modes of treatment.

Beagle, Bell, Blanco, Brilliant, Early Market, Presley and Rommel are seedlings by T. V. Munson, the noted expert of Denison, Texas. Several years trial indicates that they are not adapted to the climate of this locality.

Berlin, white, and Hosford, black, are seedlings originated by George Hosford of Ionia, Michigan. They are understood to be of pure *labrusca* parentage (Concord seedlings), and experience so far affords promise of value as market varieties.

Chidester 3, purple, and Chidester 4, red, received in 1892; also Lyon, white, received in 1895, are seedlings by C. P. Chidester of Battle Creek, Michigan. No. 3 is very early, and Lyon is large, beautiful and of fine quality. All are healthy and vigorous.

Elaine, Guinevra, Honey, Iris, Michigan, Olita, Pulpless and Vesta are seedlings by C. Engle of Paw Paw, Michigan. All are understood to be from seeds of Salem, or some other of the Rogers' hybrids, and hence to belong with the family, *lab.* x *vin.* Many of them manifest more or less strongly the distinctive characteristics of that family. Further trial is needful to properly determine their relative value.

Alice, received from T. J. Dwyer of Cornwall, N. Y., in 1896, and Goldstein, originating in Mississippi, and received from Thompson's Sons of Rio Vista, Virginia, in 1897, appear to be healthy and vigorous, but, of course, are not yet fruiting.

Campbell Early was received from Geo. S. Josselyn of Fredonia, N. Y., the introducer, who also sent specimens of the fruit when at maturity. The growth of spring set plants, as well as the character of the fruit received, indicate that it will probably sustain the high character given it by its originator, Geo. W. Campbell of Ohio.

Plants of four varieties, Josselyn No. 5, white; No. 7, white; No. 9, black; and No. 10 (not yet in fruit) were received from Mr. Josselyn in 1891. These rank from 8 to 10 in vigor, and the first three appear promising as market varieties.

Esther and Rockwood, received from the same source in 1892, are both above medium in quality; productiveness yet undetermined.

Plants of a seedling originating with Mrs. Mason of Ottawa county, Michigan, were received for trial in 1892, and have now fruited. The bunch is small, compact; berry, dark reddish amber and of fair to excellent quality.

Victoria, the white variety originated by the late T. B. Miner, was received in 1892 from Geo. W. Campbell of Ohio. A variety under this name, but black in color, has been received from two or three other sources. It is apparently not Ray's Victoria, which is light amber in color.

PLUMS.—*Prunus.*

The pruning of plums was commenced on March 20th and continued from time to time as weather permitted. The work was completed on March 27th.

Examination by Prof. Taft betrayed the presence of Putnam scale upon several plum trees, on March 31st these being yet dormant were sprayed with kerosene emulsion, consisting of one-fourth kerosene as applied to a part of the trees, and one-sixth kerosene as applied to others. Owing to strong wind, the emulsion could only be applied to one side of the trees at this time.

On April 1st and 2d the remaining plums were treated with emulsion consisting of five gallons of kerosene, six pounds of whale oil soap and forty gallons of water.

On June 26th large numbers of aphides were discovered upon several plum trees. These were treated with a strong decoction of tobacco. This so far stupified them that they dropped to the ground, apparently dead.

They, however, recovered after several hours, and started to resume their attack upon the foliage, but were treated this time with emulsion, composed of a gallon of kerosene and a gallon of whale oil soap in fifty gallons of water, which proved effectual.

July 1st and 2d shot-hole fungus and also brown rot of the fruit appearing upon several plum trees, they were sprayed with Bordeaux mixture, using four pounds of copper sulphate and six pounds of stone lime, in fifty gallons of water.

Tabulation of Plums—Prunus—1897—Concluded

No.	Names.	Species.	Planted.	Vigor—Scale 1 to 10.	Bloomed.	Ripe.	Form.	Color.	Adhesion.	Weight of specimen in ounces.	Productiveness—Scale 1 to 10.	Quality—Scale 1 to 10.	Remarks.
34	Giant Prune	Domestica	1895	8	May 10	Sept. 21	o	p	f	2	1	6-7	New. Needs further trial.
35	Glass	Domestica	1890	9	" 7	Aug. 31	r	b	c	2	1	6-7	First fruited here this season.
36	G. No. 4	Domestica	1890	9-10	" 8	" 31	r	p	c	1	1	7-8	From New York. So far unproductive.
37	Gold	Triflora	1895	6-7	" 17								Seedling by Luther Burbank.
38	Golden Prune	Domestica	1894										Not yet fruited here.
39	Grand Duke	Domestica	1890	8-9	May 6	Sept. 9	o	p b	c	3	2	4-5	Very promising for market.
40	Genii	Domestica	1890	9	" 8	" 2	r	p	f	1	9	5-6	A popular market plum.
41	Hale	Triflora	1896	10									Japanese. Not yet fruited here.
42	Hawkeye	Americana	1888	8									One of the best of this species.
43	Hungarian	Domestica	1888	10	May 8	Aug. 31	r	p	f	1	2	6-7	Identity yet rather uncertain.
44	Jewell	Americana	1890	5	" 12								Not valuable here.
45	Kelsey	Triflora	1890	8	" 19								Will not ripen here.
46	Kerr	Triflora	1897										Japanese. Not fruited here.
47	Kingston	Domestica	1890	10	May 7	Sept. 2	o	b	c	2	8	6	Very promising. Market.
48	Korai Quetsche	Domestica	1894	8-9									Hungarian. Not yet in fruit here.
49	Large Green	Domestica	1894	5									Not yet in fruit here.
50	Lincoln	Domestica	1890	7-8	May 8	Aug. 21	r o	r p	f	2	1	8	So far, lacks productiveness.
51	Lombard	Domestica	1890	8 9	" 8	" 31	r	p	c	1	10	5	Less valued than formerly.
52	Long Fruit	Triflora	1890	10	" 7	" 2	r	r	f		1		Identical with Yosebe.
53	Lyon	Domestica	1890	9-10	" 8	Sept 7	r	g w	f	2	1	7-8	Renamed thus by Mich. Hort. Society.
54	Mammoth Prune	Domestica	1895						f				Not yet fruited here.
55	Marianna	Cerasifera	1890	10	May 7	Aug. 21	o	r	c		1	6-7	Unproductive. Only valued for stocks.
56	Marshall	Domestica	1892										Not yet fruited here.
57	Maru	Triflora	1890	8	May 6	Aug. 27	r	r	c	1	10	5	Over productive. Needs thinning.
58	Marunka	Domestica	1885										Russian. Lacks productiveness.
59	McLaughlin	Domestica	1893	3-4	May 8								Not yet fruited.
60	Middleberg	Domestica	1890	8-9	" 8	Sept. 23	r o	y	f	1	9	8	Late Market.
61	Miner	Hortulana	1890	9	" 12	Oct. 6							Not valuable here.
62	Mikado	Triflora	1897										Not fruited here.
63	Mistake	Domestica	1896	7-8	May 17								Not fruited. Name objectionable.
64	Moldavka	Domestica	1888	9	" 8	Sept. 6	o	y	f	2	1	6-7	Russian. Lacks productiveness.
65	Monarch	Domestica	1893	9	" 7	" 27	o	p	f	2	4	7	Highly promising.
66	Moreman	Hortulana	1890	10	" 12	Aug. 6	ob	r	c	1	4	6	Among the finest of the species here.
67	Murdy	Domestica	1892	9	" 10	Sept. 23	r o	p	c	3	1	7-8	Not yet properly tested.
68	Muscat *Free*	Domestica	1894	6-7									Hungarian. Not yet fruited

69	Newman	Angustifolia	1890	8	" 18	Oct. 6							Lacks value here.
70	Nicholas	Domestica	1890	9	" 10	Sept. 6							Requires further trial.
71	Odell	Domestica	1896										Not yet fruited here.
72	Ogon	Triflora	1890	9-10	May 7	Aug. 3	r	y	f	1	10	2-3	Productive, showy, poor.
73	Orel, 20	Domestica	1888	7-8	" 8								Not yet fruited.
74	Pottawattamie	Hortulana	1894	10	" 10								Value here very doubtful.
75	Prairie Flower	Hortulana	1890	5-6	" 12								Worthless here.
76	Red June	Triflora	1894	10	" 6	Aug. 16	r o	r p	c	2	4	8-9	So far, the best of this species.
77	Red Nagate	Triflora	1890	9-10	" 8	" 31	r o	r	c	2	9	5-6	Only second to the foregoing.
78	Robinson	Angustifolia	1890	9-10	" 10	" 27	r	r	c	1	9	5	The most productive native here.
79	Saratoga	Domestica	1890	10	" 8	" 26	r o	r	c	2	1	6-7	Beautiful and good; market.
80	Satsuma	Triflora	1890	10	" 3	" 31	r o	p	c	2	2	7-8	Excellent; culinary variety.
81	Sergent *Robe*	Domestica	1893	8-9	" 10								Not yet fruited here.
82	Shipper	Domestica	1890	10	" 8	Aug. 30	o	b	c	2	4	5-6	Market only.
83	Shiro Smomo	Triflora	1890	9	" 3	" 4	r o	r p	c	1	10	5-6	Too productive; must be thinned.
84	Shropshire	Domestica	1890	10	" 8	Sept. 27	r o	b	s	1	4	6-7	One of the numerous Damsons.
85	Silassy	Domestica	1894	7									From Hungary; not fruited.
86	Simon	Simoni	1888	8	Apr. 30		ob	y r					Large, showy; scarcely eatable.
87	Simpson	Domestica	1896	8									Not yet fruited here.
88	Spanish *King*	Domestica	1890	9-10	May 8	Aug. 26	r	p	c	1	10	4-5	Promising; market.
89	Spaulding	Domestica	1890	8 9	" 8	Sept. 6	o	y	c	1	1	8-9	Requires further trial.
90	Splendor	Domestica	1895	8	" 17								Not yet fruited here.
91	Stark *Gage*	Domestica	1894	10	" 13								Not yet fruited here.
92	Steptoe	Domestica	1895	10	" 15								A Pacific coast prune.
93	Szillassy Piros	Domestica	1895										Imported from Hungary.
94	Throop	Domestica	1895	10	May 17								New; not yet fruited here.
95	Van Buren	Americana	1890	3-4	" 12	Sept. 27	r	r y	f	1	5	5-6	Worthless here.
96	Victoria	Domestica	1890	8-9	" 10	Aug. 27	o	r	f	2	3	6-7	Promising for market.
97	Violette	Domestica	1896	3 4	" 7								Old; not yet fruited here.
98	Wales *Prince*	Domestica	1892	7-8	" 8	Sept. 9	o						Not yet fruited here.
99	Wangenheim	Domestica	1890	10	" 10	Aug. 27	o	b	f	1	8	5	Productive; German.
100	Weaver	Americana	1890	7-8	" 10								Not desirable here.
101	White Kelsey	Triflora	1897										Not fruited here.
102	White Queen	Domestica	1894	8-9									Not fruited here.
103	Wickson	Triflora	1895	9-10	May 7			r					Very large; productive; good.
104	Willard	Triflora	1894	7-8	" 10								Not yet fruited here.
105	Wyant	Americana	1890	8	" 12	Sept. 25	r o	y r	f	1	3	7-8	Better farther west.
106	Yellow Aubert	Domestica	1888	9-10	" 8	" 8	o	y	c	2	1	7	A Russian importation; promising.
107	Yellow Egg	Domestica	1893	10	" 8	" 23	o	y	c	2	1	4-5	Old; very large; market.
108	Yosebe	Triflora	1890	10	" 7	July 24	r	r	f	1	1	2-3	Small; the earliest plum.
109	Yosemite Yellow	Americana	1892	5	" 10	Sept. 30		y					Not desirable here.
110	Youngken *Golden*	Domestica	1896	7									Not yet fruited here.

PRUNUS.—*Americana.*

This species has heretofore been understood to include the entire group of wild, native varieties, except those classed as *chicasa*, but the more recent introduction of many such varieties to cultivation has betrayed such wide differences of important characteristics that the process of segregation is in progress, though perhaps not yet complete.

Of those tested here, grouped as *angustifolia:*

Newman is but partially tested, and must be regarded as of doubtful value.

Robinson is one of the most profitable of the *Americanas*, though by no means comparable with many of the *domesticas* for localities, in which the latter are successful.

Of those designated as *cerasifera:*

Marianna, only, is under trial here. So far it is a vigorous grower, but exceedingly unproductive. Here it does not propagate readily from cuttings, as is said to be the case farther south.

Of those grouped as *hortulana:*

Moreman is beautiful and of good quality. Here it is the best of this group, though none of them are valuable.

PRUNUS.—*Domestica.*

This is the species heretofore chiefly grown in Michigan. It includes European varieties, together with seedlings of this type originating in America. Of these Bavay, Black Diamond, Bradshaw, Shipper and Yellow Egg have been long and thoroughly tested, and may safely be extensively planted for commercial purposes.

The following, though less thoroughly tested, may be regarded as worthy of extensive trial for the same purpose, viz: Arch Duke, Field, Grand Duke, Kingston, Middleburg, Monarch, Murdy, Saratoga, Spanish *King*, Victoria and Yellow Aubert.

Bavay, Coe, Columbia, Lincoln and McLaughlin are varieties well adapted to planting in the home plat.

Nearly thirty of the tabulated varieties of this species have either not yet fruited, or have borne too lightly to suffice for adequate description.

PRUNUS.—*Simoni.*

The form known as Simon or Apricot plum is large and showy. It is said, farther south, to be of tolerable quality, but here its quality is so low as to render it worthless, save, perhaps for exhibition purposes.

PRUNUS.—*Triflora.*

The above seems now to be generally recognized as the appropriate and preferred specific name of the group known as Japanese plums, which were, for a time, designated as *hattan.*

Abundance is a name applied to what was previously known as Botan, a name which, according to the rules of pomology, is entitled to precedence.

Burbank, and yet more recently, Red June, are largely superseding the Botan in popularity. Red June seems likely to win precedence on account of its slightly improved quality, large size, and especially the more satisfactory habit of the tree, which is upright, while Burbank is spreading and almost drooping.

Kelsey fails to mature its wood within our season. It is only adapted to the climate of California and the extreme south.

Long Fruit and Yosebe, as received from Georgia, are obviously identical. The fruit is very small and of indifferent flavor, usually ripening about the middle of July.

Maru and Shiro Smomo in form and color are much like Botan, though of smaller size and earlier. They are excessive bearers.

Ogon is of good size and bears moderately, but the fruit, though beautiful, is sadly deficient in quality.

Red Nagate, as received from Georgia, is much like Red June, though somewhat less in size and otherwise distinct.

Satsuma, owing to its color, is frequently gathered before full maturity. Here it is sufficiently productive, and when fully matured is one of the best of the species for culinary purposes. Trees received here as Chabot have now fruited and prove identical with the above.

Trees received as Gold, Hale, Kerr, Mikado and Willard have not yet fruited.

Wickson showed more or less bloom last spring, but failed to fruit this year, though maturing a few fine specimens last year upon year old grafts.

PEARS.—*Pyrus communis.*

The cold, backward spring of 1897 held pears, in common with other fruit trees, in a dormant condition much later than usual, and while in this condition they, in common with other trees, received a thorough spraying, the needful pruning having been done during mild weather in early March.

June 1st and 2d gave pears a spray of Bordeaux, adding three ounces of Paris green to each barrel of water, as a preventive of scab and codling moth.

June 18th sprayed pears with copper sulphate (one pound in 50 gallons of water) to prevent scab, adding three ounces of Paris green for codling moth.

July 6th repeated the foregoing for the same purpose.

July 26th, drouth being very severe, several young pear trees, which had become seriously enfeebled, were treated with two quarts of bone meal, one quart of nitrate of soda and one peck of ashes. The whole was well mixed with the soil about the trees which were then thoroughly watered.

Crimson clover was sowed among pears on August 2d and 3d after a moderate shower. This started promptly, but the immediate occurrence of hot, drying weather ruined much of it, except where more or less shaded. The stand of plants is therefore more or less imperfect.

August 14th the *slug* having attacked the foliage of a few pear trees; they were dusted with air-slaked lime.

Several pear trees were at different times attacked by blight, which was promptly cut away and burned. Only in one or two cases has it become necessary to wholly remove the trees.

TABULATION OF PEARS—*Pyrus Communis*—1897.

Abbreviations.—Season, months—b, beginning; e, end; m, middle. Form—i, irregular; o, oblate; ob, oblong; obo, obovate; obt, obtuse, ov, ovate; p pyriform; r, round; t, turbinate. Color—b, brown; c, crimson; g, greenish; r, red; ru, russet; w, whitish; y, yellow. Texture—b, buttery; f, firm; g, granular; m, melting; t, tender. Flavor—a, acid; as, astringent; j, juicy; s, sweet; v, vinous; p, perfumed. Use—d, dessert; k, kitchen; m, market.

Number.	Names.	Planted.	Bloomed.	Season.	Vigor.—Scale 1-10.	Origin.	Ounces.—Weight.	Form.	Color.		Texture.	Flavor.	Quality.—Scale 1-10.	Use.
									Skin.	Flesh.				
1	Alphand	1892			6									
2	Angouleme	1891	May 8	Oct.	9	France	12	ob obo	y ru	w	b m	j v	5-6	m
3	Anjou	1888	" 8	e Oct.	8-9	France	10	ob p	y ru	w	m	j v p	8-9	d m
4	Ansault	1889	" 12	e Sept.	5-6	France	6	obo obt p	y ru	w	m	s v	5-6	m
5	Ayer	1896												
6	Barry	1892	May 15	Dec.	8	California	6	p	y ru	w	m	j s v	5-6?	d m
7	Bartlett	1891	" 10	m Sept.	8	England	7	obo obt p	y ru	w	b t	v p	6-7	d m
8	Bartlett Seckel	1894			7	America								
9	Baudry	1896			5									
10	Beauty *Sum*	1895			10	Texas								
11	Bloodgood	1888	May 8	m Aug.	9 10	New York	4	t obo	y ru	y w	b m	s p	5-6	d
12	Bordeaux	1892			10	France								
13	Bosc	1888	May 12	e Oct.	7-8	Belgium	10	pi	y c ru	w	m b	j p	10	d m
14	Boussock	1891	" 12	b Oct.	9	Belgium	8	r obo	y ru	w	b m	j s p	5-6	m
15	Brandywine	1888			10	Delaware								
16	Buffum	1891	May 17	m Oct.	10	Rhode Island	6	obt obo	y	w	t b g	j s	5 6	m
17	Clairgeau	1891	" 10	e Sept.	6-7	France	6	pi	y c ru	y	b g	s p v	4-5	m
18	Clapp *Favorite*	1888	" 12	b Sept.	10	Massachusetts	9	t	y b ru	w	b m	s v	6-7	d m
19	Col. Wilder	1896			6-7	California								
20	Comice	1891	May 8	m o Oct.	9	France		r obt p	g b	w	b m	j s p	8 9	d m
21	Congros	1890	" 12	e Sept.	10	France	12	r obt p	y r	w	b m	j p	5-6	m
22	Dana Hovey	1888	" 13	Oct. Nov.	9-10	Massachusetts	4	obo obt p	y ru	y	m	j s p	10	d
23	Dearborn	1891	" 13	b Sept.	10	Massachusetts	5	r p	y	w	m	j s	8-9	d
24	Desportes	1891			8	France	2	obo obt p	g y r	y w	m g	j s a		
25	Dorset	1895			9							j v		
26	Drouard	1890			10	France ?								
27	Duhamel	1891	May 8	m Oct.	7	France	4	obo obt p	y ru	w	m g	j s	7-8	d ?
28	Early Duchess	1892	" 1	b Oct.	8	France	7	obo obt p	y r c	w	t b m	j v	6-7	m
29	Edmonds	1889	" 17	Oct.	9-10	New York	5	obo obt p	g y	w	f m	j s	5-6	m
30	Elizabeth, *Manning*	1891	" 8	e Aug.	10	Belgium	3	r obo	y r	w	m	j s p	8-9	d
31	Esperon	1891	May 8	m Oct.	10	Belgium	5	r obt p	y c	w	g m	v j	4-5	m
32	Fitzwater	1891	" 10	b Oct.	7	New York	4	obo obt p	y ru	w	g m	s	8 9	d
33	Flemish	1891	" 17		10	Belgium		obo obt p	y r ru	y w	f m	s j p	5 6	m
34	Fox *B. S.*	1892			6 7	California								
35	**Fred Clapp**	1888	May 13		9-10	Massachusetts								

36	Gakovsk	1888	" 8	m Aug.	5	Russia	3	p	g y		b	v	4	m
37	Gansel *Seckel*	1892			9	England								
38	Garber	1894			10	America								
39	Giffard	1888	May 8	m Aug.	9	France	4	p	y r ru	w	m	v	9-10	d
40	Gray Doyenne	1888	" 8	b Oct.	7	France ?	5	ov obo	c ru	w	b m	v	8-9	d
41	Groveland	1890			5-6	Alabama								
42	Grumkower	1891			7-8	Europe								
43	Hardy	1888			10	?								
44	Henry	1896			8-9	Illinois ?								
45	Heyst *Emile*	1893			7	Belgium								
46	Hoosic	1888			9	Massachusetts								
47	Howell	1888	May 10	m e Sept.	8	Connecticut	8	r p	y ru	w	m	v j	5-6	m
48	Idaho	1893			9	Idaho								
49	Jones	1889	May 15	Oct.	8	Pennsylvania	3	obo p	y c ru		g b	s v	5-6	d
50	Josephine	1890	" 10	m Oct.	10		7	r ov obt	y c ru	w	b m g	s	8-9	d
51	Koiffer	1891	" 4	e Oct.	10	Pennsylvania	6	r obt p	y c ru	w	m g	v	4-5	m
52	Koonce	1895			8	Illinois								
53	Kentucky	1891			10	Kentucky ?								
54	Kraus 18	1895			7	New York								
55	Kraus 41	1895			8	New York								
56	Lady *Clapp*	1895			5	Massachusetts								
57	Lawrence	1888	May 12	Nov , Dec.	7-8	New York	5	obo obt p	y ru	w	m	s j p	8-9	d m
58	Lawson	1889	" 10	m Aug.	10	New York	5	obo p	y r	w	b	s	3-4	m
59	Lincoln	1894			8-9	America								
60	Longworth	1891			10	Ohio ?								
61	Louise *Jersey*	1891				France								
62	Lucrative	1888	May 12	m e Sept.	8	Europe	6	obo p	y ru	w	m	j s	8-9	d m
63	Lucy Duke	1892	" 13		9									
64	Margaret	1889	" 10	e Aug.	8-9	Ohio	4	obo	y g	w	t b	j v s	8	d
65	Marguerite *Petite*	1889	" 10	b Aug.	8-9	France	2	o obt p	g y b	w	b m	j s p	5-6	d
66	Marshall	1893			9-10	New York								
67	Mas *Près*	1896				Belgium								
68	Maynard	1896				Pennsylvania								
69	Millett *Mad.*	1891	May 8	Nov., Jan.	8-9	Europe	7	r obo	y ru	w	f	v		
70	Mount Vernon	1888	" 8	Nov.	9	Massachusetts	6	r obt p	y b ru	y	g m	v j p	5-6	k m
71	Ogereau	1891	" 8	m Oct.	9	Europe?	9	ob obt p	y r	w	b	j v	6-7	m
72	Olivier	1893				France								
73	Onondaga	1891	May 12	e Sept	10	New York	6	ov obo obt p	y ru	w	g b	v j	7	m
74	Osband	1891			9	" "								
75	Pitmaston	1891	May 12	e Oct.	10	England	17	ob obo p	y ru	y w	m b	v j	7-8	m
76	Reeder	1890	" 8	m Oct.	9	New York	8	r ov obt p	y ru	w	m b g	j s v	8-9	d m
77	Reliance	1893			8-9	America?								
78	Rostiezer	1888	May 11	e Aug.	9-10	Europe	3	obo p	y b ru	w	m b	s p	10	d
79	Rutter	1892	" 8	b Oct.	10	Pennsylvania	9	r p	y ru	w	f g m	s v	7	m
80	Seckel	1888	" 12	b m Oct.	8-9	"	8	obo	g b ru	w	b m	s v p	10	d

TABULATION OF PEARS, 1897.—*Concluded.*

Number.	Names.	Planted.	Bloomed.	Season.	Vigor.—Scale 1-10.	Origin.	Ounces—Weight.	Form.	Color.		Texture.	Flavor.	Quality.—Scale 1-10.	Use.
									Skin.	Flesh.				
81	Seneca	1894			8	New York?								
82	Sheldon	1890	May 10	m e Oct.	10	" "	4	r obo	y b ru	w	m	j s v p	7-8	m
83	Sterling	1888	" 8	e Aug	10	" "	5	r ov	y c ru	w	m	j s	5 6	m
84	Stout	1896				America?								
85	Sudduth	1896			5	Illinois								
86	Summer Doyenne	1888	May 12	b Aug.	8-9	Belgium	2	r obo p	y r	w	m	j s	4 5	d
87	Superfin	1891			10	France								
88	Tyson	1888			10	Pennsylvania								
89	Van Cott	1893			5									
90	Vermont	1894			8	Vermont								
91	Vicar	1891			10	France								
92	Victor	1891	May 17		10									
93	Wilder *Early*	1889	" 15		8	New York								
94	Winter Nelis	1888	" 13	Nov , Dec.	7-8	Belgium	4	r obo	y g ru	y w	b m	j v p	10	d m
95	Worden *Seckel*	1896			5	America?								
96	Zache	1894	May 12	e Oct.	10	?	10	r o	y	w	g	s	2-3	k

The following varieties are named, as nearly as practicable, in the order of their ripening. The list includes the *cream* of those fruited here and known to be generally successful in this state, and well worthy of a place in the home plantation, viz: Summer Doyenne, end of July; Bloodgood, b August; Giffard, m August; Margaret, e August; Rostiezer, b September; Clapp *Fav.*, b m September; Lucrative, e September; Elizabeth *Manning*, September; Seckel, October; Bosc, October; Comice, October, November; Anjou, October, November; Dana Hovey, November, January.

The following can be relied on to supply a market with a succession of varieties of fair quality and attractive appearance during the usual season, viz.: Clapp *Fav.*, b m September; Bartlett, m e September; Boussock, September, October; Howell, September, October; Angouleme, October; Bosc, October; Sheldon, October; Anjou, October, November; Ogereau, October, November; Rutter, October, November; Reeder, November; Clairgeau, October, December; Mount Vernon, November, December; Lawrence, December; Winter Nelis, December, January.

Ansault (Bonne du Puits Ansault) is a fine pear of medium size and quality. Is, so far, a profuse and constant bearer, and must be severely thinned to maintain the health and vigor of the tree. Promising for market.

Coreless. Trees received from a Missouri nursery, under this name, bore a fine crop of fruit last year and proves to be identical with Flemish.

Bessemianka, Gakovsk, Kurskaya and Victorina are Russian varieties of low quality and valueless here.

Congres (Souvenir du Congres), though of only medium quality, is very large and beautiful under favorable conditions, but severe pruning and thinning, together with intensive culture will be found indispensable to the realizing of such result.

Trees of Fitzwater pear, planted in 1891, made fairly vigorous, healthy growths for several years, but from some unknown cause they have made but feeble growth during the last two years. Copious watering during drouth, together with the application of special fertilizers, have been resorted to with apparently promising effect.

Lawson, popular for a time in eastern New York as a market variety has fruited here this year. Its fine size and beautiful color are its chief merits.

Onondaga ripens after the plethora of autumn fruits is past, and deserves a place in both the home and the commercial plantation as a fair dessert pear, and especially as a culinary variety.

Wilder Early, which has received high praise in certain localities, proves here to be a tardy bearer. It bloomed for the first time last spring, but failed to mature fruit.

Winter Nelis must have rich soil, and should not be allowed to overbear if its usual high quality is to be maintained.

Barry, *P. Barry*, is a comparatively recent California seedling, and an unusually long keeper. It promises unusually well as a late winter pear of high quality, but will probably require to be ripened in a warm room with special care to avoid shriveling. The tree is a straggling grower.

Pyrus sinensis.

There are but one or two varieties of this species on trial here, and these have been included in the foregoing list, rather than tabulate them separately.

Zache possesses the long slender stem, the oblate form, and the firm, coarse, granular flesh which usually characterize this species, and for that reason is assumed to be of pure *sinensis* parentage. It will be desirable, if at all, for culinary uses. Like certain others of the species, the very large, rich, glossy foliage, may even render it desirable as an ornamental tree.

Keiffer possesses peculiarities of both tree and fruit, which indicate a probable hybridization, with *sinensis* as one of the parents. If valuable at all in Michigan it is for strictly commercial purposes, upon quick, warm soils and to catch the trade of those who are won by looks rather than quality. Farther south, with longer seasons, it is improved in beauty, size and perhaps even in quality.

APPLES.—*Pyrus.*

The pruning of apples was commenced on March 29, and completed on or about April 3.

On June 2 apples (and pears also) were sprayed for scab and codling moth, using Bordeaux of ordinary strength, with three ounces of Paris green in each 40 gallons of the mixture. The spray with this mixture was repeated on June 18 for the same purpose, and was again applied on July 6 to 8.

The green aphis has been but lightly troublesome upon the apple, though a few were discovered, mostly upon small trees. These were effectively treated with tobacco decoction on June 18.

On September 25 Woolly Aphis, *Schizoneura lanigera* (Hausm), having appeared upon a few twigs of apple, a decoction of tobacco stems was applied, and this not proving fully effective they were again sprayed, this time effectively, with kerosene emulsion.

The three sprayings, though apparently effective against scab, appeared to be less so as a preventive of codling moth, a large percentage of the fruit betraying the presence of the larvae—a result perhaps due to tardy or inefficient spraying, or perchance to the adulteration of the poison used.

No insect depredations have been observed, aside from those noted in connection with spraying.

There are at present two hundred and ninety-five varieties of apples on trial upon the station grounds, of which nineteen are either crabs or supposed hybrids and are tabulated separately. Of the remainder, one hundred and thirty-five have bloomed or fruited during the current year, while one hundred and forty-one have not yet shown bloom, and are not included in the tabulation.

In grading for quality, upon the scale 1 to 10, varieties are compared with those of the same species only.

TABULATION OF APPLES—*Pyrus*—1897.

Crabs—P—baccata; including actual and supposed hybrids.

Abbreviations—Month: b, beginning; e, end; m, middle. Form: c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. Color: g, green; r, red; ru, russett; s, striped; w, white; y, yellow. Texture: c, crisp; d, dry; f, firm; j, juicy; t, tender. Flavor: a, acid; m, mild; s, sweet. Use: c, cider; d, dessert; k, kitchen; m, market.

No.	Names.	Origin.	Planted.	Bloomed.	Ripe.	Season.	Weight, ounces.	Form.	Color.	Texture.	Flavor.	Quality—Scale 1 to 10.	Use.
1	August	Minnesota	1890	May 12	Aug. 27	e Aug. b Sept.	3	r o	y r s	c f	a	3-4	k
2	Bechtel	Illinois	1894	June 5					fl pl				
3	Dartmouth	Massachusetts?	1890	May 12	e Aug.	e Aug. b Sept.	2	o	r	c j	m	10	k d
4	Excelsior	Minnesota	1890	" 12	e Aug.	b Sept.	4	r o	y r	t j	m a	6	k m
5	Florence	Minnesota	1890	" 12	e Aug.	b Sept.	2	o	y r s	t j	a	6-7	k m
6	Gibb	Wisconsin	1890	" 15	e Aug.	b Sept.	2	o c	y r	c j	m a	7-8	d k m
7	Gracie	Minnesota	1890										
8	Jolly	Minnesota	1890	May 13	e Sept.	b Oct.	2	o ob c	y r	c	a	5	k
9	Lou	Minnesota	1890	" 14	m. Sept.	e Sept.	6	r ov	y r s	t j	m	5-6	k
10	Martha	Minnesota	1890	" 17	b. Sept.	Sept., Oct.	3	o	y r	c j	m	9-10	k m
11	North Star	Minnesota	1891	" 13	m. Aug.	Aug.	2	r o	y r	c	a	6	k
12	No. 1 New	Minnesota	1890										
13	No. 2 New	Minnesota	1890	May 12	e Aug.	Sept.	5	o c	y g	c	m	6	k
14	October	Minnesota	1890	" 13	e Aug.	Sept.	6	r	r y s	c	a	5	k m
15	Peter	Minnesota	1890	" 19	b Sept.	Sept.	6	r o	r	f j	m	6-7	k m
16	Quaker		1891	" 14	m e Oct.	Oct., Jan.	2	r ov	y r	c	m s	6-7	k
17	Transcendent		1893	" 13	b Sept.	Sept.	3	r	y r	c	a	5-6	k m
18	Virginia		1894										
19	Whitney, *20*	Illinois	1890	May 12	e Aug.	Sept.	4	ov c	r y	t j	m	8-9	d m

TABULATION OF APPLES—*Pyrus*—1897.—*Continued.*

P. Malus.

Abbreviations—Months: b, beginning; e, end; m, middle. Form: c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. Color: g, green; r, red ru, russet; s, striped w, white; y, yellow. Texture: c, crisp; d, dry; f, firm, j, juicy; t, tender. Flavor: a, acid; m, mild; s, sweet. Use: c, cider; d, dessert; k, kitchen; m, market.

No.	Names.	Origin.	Planted.	Bloomed.	Ripe.	Season.	Weight in ounces.	Form.	Color.	Texture.	Flavor.	Quality—Scale 1 to 10.	Use.
1	American Blush	America	1890	May 19									
2	Arnold	Ontario	1890	" 19									
3	Babbitt	America ?	1890	" 15									
4	Bailey *Sweet*	New York ?	1888	" 15	Oct.	Nov.-Mar.	9	r	r	t	s	8-9	d k m
5	Batullen	Russia	1888	" 21									
6	Bietigheimer	Germany	1890	" 15									
7	Blue Anis	Russia	1890	" 17									
8	Borovinka	Russia	1888	" 13	e Aug.	Sept.	6	r o	y r s	c j, t	a	5-6	k m
9	Bottle *Greening*	Vermont	1890	" 12	Oct.	Jan.-Feb.		o c	y r	i	m	5-6	d
10	Bough	America	1888	" 13	e Aug.	Sept.	6	r c	y	t j	s	6-7	d k
11	Bradford	Tennessee ?	1890	" 15	Oct.	Dec.-Mar.	5	r ov	g r s	t j	m	4	m
12	Buckingham	America ?	1892	" 19									
13	Canada *Baldwin*	Quebec	1890	" 18									
14	Carlough	America ?	1889	" 19									
15	Chenango	New York	1888	" 19	e Aug.	Sept.	6	ob c	y r s	t j	m	5-6	d m
16	Clark *Orange*	America ?	1892	" 19	b Oct.	Nov.	6	r o i	y r s	t c	m	5	
17	Cogswell	Connecticut	1888	" 13	Oct.	Dec.-Mar.	8	r c o	y r s	t j	m	5	d m
18	Colton	Ohio ?	1888	" 12	m Aug	Sept.	6	o v c	g y	t	m	6	d m
19	Colvert	America ?	1892	" 17									
20	Cornell	Pennsylvania	1890	" 19									
21	Crane	Illinois	1888	" 19									
22	Cullin	America ?	1890	" 19									
23	Day	Nebraska	1891	" 17	m Oct.	Nov.-Dec.	7	r c	y ru	t	m	3-4	m
24	Decarie	Quebec	1890	" 18									
25	Dickinson	America ?	1889	" 21									
26	Dyer	France ?	1888	" 14	m Sept	Sept.-Oct.	7	r o	y r	t j	a m	7-8	d k
27	Early *Ripe*	Pennsylvania	1891	" 18									
28	Early Strawberry	New York	1888	" 18									
29	Egyptian	Kentucky ?	1888	" 19									
30	Evans	Idaho	1888	" 22									
31	Fall Pippin	America ?	1888	" 18									
32	Family *Favorite*	America ?	1891	" 18									

33	Fink	Ohio	1892	"	19								
34	Flory *Bellflower*	Ohio	1892	"	19								
35	Flushing	New York ?	1888	"	19								
36	Gano	Missouri ?	1890	"	17	m Oct.	Nov.-Mar.	11	o	y r	c t j	m	5	m
37	Garden Royal	Massachusetts.	1888	"	19	m Sept.	Sept.-Oct.	4	r o c	g y r s	t j	m	10	d
38	Gavel	Nova Scotia	1895	"	19								
39	Gideon	Minnesota	1890	"	18	Sept.	Sept. Dec.						
40	Gloege	Wisconsin	1888	"	12	Oct.	Dec.-Mar.	6	ob ov	y ru	c	m	4	m
41	Golden Reinette	Russia	1888	"	17	Oct.	Oct.-Nov.	5	o c	r y s	c	m	4-5	m
42	Golden Russett, *N. Y.*	England	1888	"	15	Nov.	Dec.-Apr.	6	r o	y ru	f j	m	7-8	d m
43	Grimes	Virginia	1890	"	18	Oct.	Dec.-Mar.	6	r ob	y	c t	m	8-9	d m
44	Grosh	Pennsylvania	1890	"	17	m Sept	Sept.-Oct.	7	r o	g y r s	t j	a	7-8	k m
45	Haas *Fall Queen*	Missouri	1892	"	21								
46	Hagoukopt	Europe	1888	"	21								
47	Hargrove	America ?	1892	"	17								
48	Hawley	New York	1888	"	18	Sept. 15	Sept.	12	r o c	y	t j	m	5-6	d
49	Hubbardston	Massachusetts	1888	"	13	m Nov.	Nov.-Jan.	12	r ov	y r s	t j	m	7-8	d m
50	Indian ?	America	1892	"	22	m Sept.	Sept.-Oct.	9	r o	y r ru	t	m	4-5	m
51	Indiana *Favorite*	Indiana	1892	"	19								
52	Iowa *Keeper*	Iowa ?	1891	"	19	Dec.	Dec.	5	o	g y r	f	m	4-5	m
53	Jacob	America ?	1890	"	18								
54	Jefferis	Pennsylvania	1888	"	15	m e Sept.	Sept.	8	r o c	y r s	t j	m	10	d
55	Jersey *Sweet*	New Jersey ?	1888	"	17	m Sept.	Sept.	6	r ov	r y	t j	s	5-6	d k
56	Jonathan	New York	1888	"	15	Oct.	Oct.-Feb.	6	r c	r y	t j	m	10	d k m
57	Keswick	England	1888	"	13	Sept.	Sept.-Oct.	7	c i	g y	t j	a	5	k m
58	Kinnaird	Tennessee	1892	"	14								
59	Kirkland	New York	1890	"	15								
60	Lady Sweet	New York	1890	"	24								
61	Lawver	Missouri ?	1890	"	18								
62	Limber Twig	N'th Carolina?	1892	"	19								
63	Longfield	Russia	1892	"	12	e Sept	Oct.-Feb.	9	r c	y r	j	m	5	k m
64	Looker	Missouri ?	1891	"	18								
65	Louise	Ontario	1890	"	18	Oct.	Oct.-Jan.						
66	Lowell	America ?	1890	"	15	m Sept.	Sept.-Jan.	10	r ob	y	t j	m	7-8	d m
67	Loy	America	1890	"	22								
68	Magog	Vermont	1890	"	18	Oct.		4	r ov	y r s	t	m	3-4	
69	Marmalade	Europe	1888	"	15	m Sept.		7	r o i	y r s		s	4-5	
70	Marshall	N. Hampshire	1892	"	14								
71	Mason *Orange*	Missouri ?	1890	"	18	Oct.	Oct.-Jan.	8	r o	y		m	5-6	
72	McIntosh	Ontario	1890	"	17	Oct.	Nov.-Feb.	6	r o	r y	t j	m	7-8	d m
73	Melon	New York	1888	"	24								
74	Minkler	Illinois ?	1892	"	17	Oct.	Jan.-Mar.	9	r c	g y r	f j	m	6-7	
75	Morris Red	America ?	1890	"	19								
76	Munson	Massachusetts?	1890	"	17	Sept.	Sept.-Feb.	4	o	y r	f j	s	4 5	k
77	Noro	America ?	1890	"	15								
78	Northfield	Vermont	1890	"	15	Sept.	Sept. Dec.	7	r o	w y r s	c	a m	5	k m

TABULATION OF APPLES—*Pyrus*—1897.—*Concluded.*

P. Malus.

No.	Names.	Origin.	Planted.	Bloomed.	Ripe.	Season.	Weight in ounces.	Form.	Color.	Texture.	Flavor.	Quality—Scale 1 to 10.	Use.
79	Nyack	America?	1890	May 21									
80	Oakland	Michigan?	1888	" 13	Oct.	Nov.-Mar.	5	o	y r s	t j	m	7-8	d m
81	Oldenburg	Russia	1892	" 13	m Aug.	Sept.	8	o	y r s	c t j	a	4-5	k m
82	Ontario	Ontario	1890	" 17	Oct.	Jan.-April	10	o	y r s	c j	m	6 7	d k m
83	Pawpaw	Michigan	1888	" 21									
84	Peck	Rhode Island ?	1888	" 18									
85	Pewaukee	Wisconsin	1892	" 19									
86	Picket	Kentucky	1888	" 13	Oct.	Dec.	6	r o c	y r s	t j	m	4-5	m
87	Pine Stump	Georgia ?	1892	" 15									
88	Primate	America	1888	" 13	m Aug.	Aug. Sept.	7	r c	y r	t j	m	9	d k
89	Prolific *Sweet*	Connecticut	1890	" 18									
90	Pryor Red *Seedling*	Illinois ?	1888	" 18									
91	Pyrus Malus fl. pl.	America?	1892	" 12									
92	Quince *Cole*	America	1892	" 19	e Aug.	Sept.	6	r c	y	c t	a	4-5	k m
93	Rambo	Pennsylvania	1888	" 18									
94	Ramsdell *Sweet*	America	1890	" 15	Oct.	Oct.-Feb.	7	ob c	r	t	s	4-5	k m
95	Red Aport	Russia	1888	" 18	b m Sept.	Sept.-Oct.	10	o c	y r s	t j	m	5	k
96	Red Astrachan	Russia	1888	" 13	m Aug.	*	6	r o c	r y	t j	a	5-6	k m
97	Red Canada	New England ?	1888	" 19	Oct.	Jan.-May	6	o c	y r	f j	m	8 9	d m
98	Red Dettmer	Russia	1888	" 17									
99	Red June	Carolina?	1892	" 16	m Aug.	Aug.	3	ov c	r	t j	m	7-8	d
100	Red McMahon	America	1894	" 16	Aug.								
101	Red Russet	N. Hampshire	1890	" 19									
102	Rhode Island	Rhode Island ?	1888	" 15	Oct.	Dec.-Mar.							
103	Ribston	England	1888	" 19									
104	Ronk	Indiana	1888	" 18									
105	Rosenhager	Europe	1888	" 13	Oct.	Oct.-Dec.	9	r o c	g y r s	f	a	5-6	k m
106	Roxbury	Massachusetts	1888	" 13	Oct.	Jan.-June	6	r o	y ru	f j	m	7-8	k m
107	Salome	Illinois	1893	" 19									
108	Scarlet Cranberry	America	1891	" 18									
109	Scott *Winter*	Vermont ?	1892	" 18									
110	Sheriff	Pennsylvania	1891	" 17	Oct.	Oct.-March	6	r ob c	g r s	t	m	7	m
111	Smokehouse	Pennsylvania	1893	" 18									
112	Somerset *New York*	New York	1892	" 18	e Aug.	Sept.	6	c	y ru	f j	a	8	d k
113	Spencer	America	1891										

114	Stark	Ohio?	1888	May	17	Oct.	Dec.-Apl.	8	r o b c	g y r s	f c	m	4-5	m
115	St Lawrence	America?	1888	"	19	e Sept.	Oct.	9	o c	y r s	f j	m	5-6	d m
116	Stewart?	America?	1890	"	18									
117	Stump	New York	1889	"	14									
118	Summer Livland	Russia	1890	"	19	m Sept.								
119	Summer Pearmain	America?	1888	"	18	b m Sept.	Sept.	5	o c	r ru	t j	m	10	d
120	Summer Rose	America?	1892	"	17	m e Aug.	Aug.	3	o	y r s	t j	m	8	d
121	Thaler?	Russia	1888	"	15	b Sept.	Sept.	4	o b	y r s		m	5	k
122	Thornton	America?	1892	"	18	Oct	Nov.	6	r ov	g y r ru	f j	m	6	m
123	Titovka	Russia	1888	"	13	m Aug.	Sept.	8	o c i	y r s	c j	m	5-6	k m
124	Tolman	Rhode Island	1888	"	17	Oct.	Dec.-Mar.	6	r o	y r	f	s	8	k m
125	Townsend	Pennsylvania	1890	"	21									
126	Wagener	New York	1893	"	13	Oct.	Dec.-Mar.							
127	Washington *Str.*	New York	1890	"	13	b Sept.	Sept.	7	o c	y r s	t j	m a	7-8	d c
128	Water	Pennsylvania	1890	"	17	Oct.	Oct.-Nov.	5	r ov c	y r	t j	m	5	d m
129	Wealthy	Minnesota	1890	"	18	m Sept.	Oct.	8	r o	y r	t j	m	6	d m
130	Whinnery	America	1890	"	12									
131	Winter Streifling	Russia	1888	"	16	m e Sept.	Sept.-Oct.	8	r o	y r s	t j	m	4-5	k m
132	Yellow Transparent	Russia	1888	"	18	m Aug.	Aug.	5	ov c	y	c j	a	3-4	k m
133	York Imperial	Pennsylvania	1892	"	19									
134	Zolotoreff	Russia	1890	"	17	e Aug.	Sept.	10	r	y r s	f c	a	3-4	k m
135	Zozoff	Russia	1890	"	13	m Sept.	"		r c	y r	t c	a	3-4	k m

* m Aug.-m Sept.

CRABS.

August, Excelsior, Florence, Gideon, Gracie, Jelly, Lou, Martha, No. 1 New, No. 2 New, and October, are all seedlings originated by Peter M. Gideon, of Minnesota, and are, by him, claimed to afford a succession of varieties adapted to the climate of that far northern region. The Cherry crab is claimed to be the parent from which these, together with the Wealthy, have been evolved; although several of them—the last especially—afford, in fruit or tree, more or less decided indication of *malus* parentage.

Bechtel is said to be of *angustifolia* parentage. Its blossoms are large and very beautiful, and as double as miniature roses.

Dartmouth is one of the largest and most beautiful of its class; with the dark, rich, glossy color of the older Hyslop.

Northfield, though tabulated in our *malus* class, is placed among crabs (doubtless correctly) by Downing.

Quaker is a late ripening variety of fair quality. The name was apparently bestowed as expressive of the peculiar, light color of the young wood of the tree, as well as the fruit, which is nearly or quite sweet, and a comparatively long keeper.

APPLES.—*P. Malus.*

A considerable number of the varieties tabulated as fruiting for the first time this season, have so failed to mature good specimens that notices and characterizations are deferred to await the more full and perfect development of their true character.

Borovinka and Oldenburg, as grown here, although distinct, resemble each other so closely in tree, fruit, season and productiveness, that a difference will scarcely be observed by the average fruitgrower.

Gano is understood to have originated in the southwest. Its fine size and showy appearance may render it profitable for market, to which it appears to be mainly adapted.

Garden Royal is by no means new, though but sparsely disseminated. Its rather small size of both tree and fruit specially adapt it to garden planting; while its evenness of size, rich color, and mild, rich flavor, render it an admirable dessert apple.

Golden Reinette, Longfield, Marmalade, Red Aport, Red Dettmer, Rosenhager, Thaler, Titovka, Winter Streifling, Zolotoreff and Zuzoff are from the Russian importations of Prof. Budd and others, although the names of several of them indicate a German origin. Thaler is probably not true to name. The trees are nearly all free growers and most of them early and profuse bearers. In this climate all ripen in early autumn and are only adapted to culinary uses.

Grimes (originally Grimes' Golden Pippin) is one of the few apples, originating in Virginia, which seems to maintain its good qualities when grown as far north as Michigan, although, so far, it lacks productiveness here.

Hawley is large, beautiful and excellent; but deteriorates rapidly after maturity.

Hubbardston is large, beautiful and excellent, whether for home or market purposes; from November to midwinter.

Indian is a fickle title, which seems to apply equally to several varieties. The one fruited here comes from Missouri, and is a medium sized September apple of scarcely medium quality.

Jefferis has no superior as a beautiful and excellent dessert apple for September.

Jersey Sweet, as a dessert and culinary sweet apple, has few if any superiors during its season.

Jonathan, as an early and midwinter apple is too widely and favorably known to require description. Here, as elsewhere, to give thorough satisfaction, it should have rich soil and good culture.

Louise, *Princess Louise*, is a comparatively recent Ontario seedling, with many characteristics of the Fameuse family of apples. Promising for both dessert and market.

Lowell is an early and profuse bearer—a fair market variety for September.

McIntosh is another apple of the Fameuse type, of Canadian origin; apparently possessing desirable qualities for both dessert and market, especially at the North.

Minkler is perhaps an old variety, unidentified and renamed. It is more popular farther west.

Munson is a desirable and very beautiful sweet apple; well worth a place, where a sweet apple of that season is desired.

Oakland, *Oakland County Seeknofurther*, is a popular variety in Oakland County, Mich., and quite possibly may be an unrecognized and renamed old apple. Here the tree is an unusually slender, spreading grower, and an early bearer. Fruit beautifully blushed, with a mild, rich flavor.

Ontario, originating in the province of that name, is said to be the result of a cross, between Northern Spy and Wagener, by the late Charles Arnold. The tree proves to be an early and profuse bearer, and the large, fine, fruit keeps well till spring.

Primate has no superior as an August dessert apple; with the drawback, however, that overgrown specimens are likely to become watercored. Its delicate texture, together with its habit of ripening in succession, to some extent, unfit it for the market.

Quince (of Cole) is an old, very highly flavored apple, especially fine for culinary purposes.

Ramsdell *Sweet*, *English Sweet*, of Downing, is excellent as a late autumn and early winter sweet apple.

Red Astrachan is so well and widely known as scarcely to require mention. For market, it somewhat lacks productiveness.

Red Canada, so long the most popular market winter apple in Detroit and Chicago markets, under the pseudonym—Steel's Red Winter, is no longer successful in the eastern Michigan region where it was once so extensively grown, largely, no doubt, owing to the increased depredations of insects and fungi, and perhaps even more largely to the depletion of soils from continual cropping, without adequate fertilizing. The variety is said to be inclined to scab and crack on some light soils; still it may reasonably be hoped that careful, thorough fertilizing and spraying may largely overcome these difficulties, and, possibly, to some extent, restore its lost prestige. The variety is now fruiting at this station, and even on very light soil, is showing perfect fruit.

Red June is highly valued as an early apple of fine flavor and great beauty. In Michigan it is inclined to scab, crack and overbear.

Roxbury is not quite hardy in Michigan. The tree is of low, spreading habit. The fruit, if kept in close packages to prevent shriveling, is one of the best long keepers.

Sheriff originated in Pennsylvania. Though not of high quality, it is valued farther west, on account of the hardiness of the tree.

Somerset, *N. Y.*, is an early apple of high, sprightly flavor. The tree is an unusually early bearer.

Stark is valued for market, on account of the hardiness, vigor and productiveness of the tree. It is a long keeper, though quite low in quality.

St. Lawrence, ripens at a season when there is an excess of fruits, on which account its real merits are, to some extent, overlooked. It is attractive and valuable, both in tree and fruit.

Summer Pearmain, but for the tendency of the fruit to scab and crack, and that it ripens in the height of the peach, plum and grape season, might well be placed at the head of the list of dessert apples, so far as both beauty and quality are concerned.

Summer Rose, although not the equal of the foregoing in either size or quality, is yet of satisfactory size and quality, and even more beautiful.

Thornton, if at all valuable, is so on account of the vigor and productiveness of the tree. The fruit, though of fine size, is unattractive in appearance and low in quality.

Tolman, *Talman Sweet*, though a very popular long keeper, is objectionably firm and tough in texture, and also lacks juiciness.

Washington *Strawberry*, though ripening in early September, and less desirable for that reason, is large, beautiful, and an early bearer. A good culinary apple.

Water, is an early, profuse bearer, and the tree of good habit, but the variety has many rivals, with equal and even superior merit, at least for this locality.

Wealthy, originated by Peter M. Gideon, of Minnesota, as alleged, from seed of Cherry crab, but its obvious freedom from all indication of crab parentage, begets the suspicion that, by mixture of seed or otherwise, an error may have occurred. Though a winter variety and fairly hardy at the extreme north, it ripens in October in Southern Michigan, where it is only a medium dessert and market fruit.

QUINCES—*Cydonia.*

TABULATION OF QUINCES—*Cydonia*—1897.

Name.	Planted.	Bloomed.	Ripe.
Alaska	1891	May 22	Middle of October.
Angers	1890		
Bourgeat	1895		
Champion	1888	May 31	End of October.
Fuller	1891	May 29	
Hong Kong	1888		
Meech	1888	May 31	Middle of October.
Missouri	1890	May 22	Middle of October.
Orange	1888	May 22	Beginning of October.
Rea	1888	May 22	Beginning of October.
Van Deman	1895		

Quinces were included in the spraying to which the entire plantation was treated, while yet dormant.

July 1st they were sprayed with Bordeaux in connection with the plums with which they are alternated.

Neither insects nor fungi have been observed attacking either plants or fruit of the quince during the season.

Angers, Bourgeat, and Van Deman, have not yet fruited here.

Hong Kong was planted here as early as 1888. It has proved hardy, and has made moderate annual growth, but has neither bloomed nor fruited.

Champion cannot be depended upon to fully ripen, even in average seasons in Southern Michigan.

NUTS, 1897.

ALMONDS.—*Amygdalus communis.*

Luelling, a hard shelled variety, planted in 1892, is hardy and vigorous in this climate. It bloomed on April 29 and ripened the last of October to the first of November. The fruit, though of fine size, proved nearly neutral in flavor. Much of the foliage dropped before the fruit matured.

Soft Shell, planted in 1892, has also proved hardy here. It bloomed for the first time on April 29 last and ripened a light crop of nuts, which were gathered about the middle of October. Although pleasant in flavor they scarcely equaled those offered for sale commercially. This variety also dropped a portion of its foliage prematurely.

CHESTNUTS.—*Castanea.*

The soil of the location in which chestnuts were planted is apparently not suited to their needs, owing perhaps to retentive clay subsoil a foot or two beneath the surface. Apparently from this cause several varieties have failed, after a year or two of growth.

Of those remaining, Comfort, Hathaway and Japan Giant, have not yet fruited.

Numbo partially matured several burs last autumn from buds which should have remained dormant till spring. As a result it has made little growth and shown no fruit the past season.

Paragon produced a fine crop of nuts the past season, setting far more than it could mature.

Spanish (a seedling of the European type) has also fruited abundantly, although the nuts are rather small for that species and of low quality.

FILBERTS AND HAZELNUTS.—*Corylus.*

Cosford, *Thin Shell* filbert, is yet growing satisfactorily, but has not yet fruited.

Hazelnut plants, received from the national division of pomology in 1892, though healthy and vigorous, have not yet either bloomed or fruited.

Kentish Cob filbert, planted in 1892, is again showing an abundance of catkins, but so far has failed to fruit, though growing satisfactorily, and not noticeably injured by the cold of winter.

PECANS.—*Hickoria (Carya) olivaeformis.*

Trees of this, grown from Iowa seed, prove hardy here, having stood unprotected without injury, since the nuts were planted in 1890.

Seedings of Stuart pecan, grown from Texas seed, planted in 1894, although mounded with earth each winter, have yearly been killed nearly to the collar, till in the autumn of 1896, when they were trussed with straw, and earthed up still more deeply, and came out the next spring, nearly or quite uninjured. They were planted in orchard, and are are thoroughly trussed with straw, and mounded with earth.

WALNUTS—*Juglans.*

Japan Walnut—*Juglans Seiboldii*, in both tree and fruit, somewhat resembles our native butternut, though the tree is even more vigorous, with large and more glossy foliage, and the smaller and less roughened nuts are produced in greater abundance.

Persian, English or European Walnut, known also as Madeira nut, *Juglans regia*, though apparently hardy here, makes but moderate annual growths, and, though planted in 1890, does not yet afford indications of fruiting.

Praepaturiens, a dwarf variety of the foregoing, planted in 1890, has not yet fruited.

Thin shell, planted in 1894, is also, apparently, a variety of this species.

APRICOTS—*Armeniaca vulgaris.*

Harris, a variety originating in Central New York, and said to be productive and profitable there, is the only variety now on trial here. It has not yet fruited.

The Russian varieties, for a time highly commended farther west, were on trial here for several years, without satisfactory results. They have been dropped from our lists.

MULBERRIES—*Morus.*

Downing is scarcely hardy enough, even in our Lake Shore climate.

Hicks is a Southern variety and quite popular there, but it fails to maintain its qualities in our Michigan climate.

New American is hardy and very productive. Its fruit ripens in succession, during a period of six or eight weeks, and is of fine size and very pleasant flavor.

NECTARINES—*Persica vulgaris.*

Pitmaston bloomed the past year, for the first time, on May 4th, and set a light crop of fruit, which, however, was ruined by the curculio, not a specimen escaping.

Kentucky, understood to be a recent seedling from that state, comes to us, in bud, from the National Division of Pomology. The buds were inserted, in 1896, in a tree of bearing age, and may, perchance, fruit the coming year.

ASPARAGUS—*Asparagus officinalis.*

Palmetto may still be regarded as the preferable one among the older varieties.

Columbian, *Mammoth White*, which has been planted more recently, is even superior to the former in some respects.

Owing to its diœcious character, it would seem doubtful if the peculiar characteristics of a variety can be maintained in the process of reproduction from seed, otherwise than by the isolation of the seed-bearing parent, and farther, by the selection of the young plants, with careful reference to the desired type.

RHUBARB—*Rheum rhaponticum.*

The plantation of rhubarb having become crowded and deteriorated, on account of long standing in the same ground, the plants have now been removed and a new plantation made.

Linnæus, has pretty well demonstrated its superiority as compared with the varieties with which it has been tested, although its superiority as compared with several others is but slight.

Bailey, received from S. S. Bailey, of Kent county, Michigan, is the only variety replanted for farther trial.

T. T. LYON.

South Haven, Mich., January 15, 1898.

VEGETABLE TESTS OF 1897.

BY L. R. TAFT, H. P. GLADDEN AND M. L. DEAN.

Bulletin 153.—Horticultural Department.

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As in previous years we grew most of the new varieties sent out by the seedsmen, as well as many of the standard sorts, and kept careful notes upon their behavior. We also undertook quite a line of experiments in methods of culture and the use of various fertilizers, particularly with potatoes and celery, but the excessive rains during August so affected the results as to make it impossible to draw correct conclusions.

BUSH BEANS.

Variety.	Seedsman.	Date edible.	Number of pods on one plant.	Weight of pods on one plant. Ounces.	Average weight of single pod.
Black Valentine	Henderson	July 26	71	11½	.162
Cream Valentine	"	" 29	109	20½	.187
First in Market	Landreth	" 26	90	10	.111
Fuller Black Wax	Gregory	" 28	108	18½	.171
Improved Goddard	Ferry	Aug. 7	61	11	.180
Lima Wax	Dreer	" 9	97	9	.093
Refugee	Livingston	" 7	63	9	.143
Stringless Green Pod	Burpee	" 2	121	20½	.169
Union White Valentine	Johnson & Stokes	" 21	16	2½	.156
Vineless Marrow	Ferry	" 16	43	7½	.174
Warren	Gregory	" 7	58	6½	.112
Yosemite Wax	Johnson & Stokes	" 2	110	17	.155
Byer's One Bean	Byer Bros.	" 11	271	47	.169

NOTES ON VARIETIES.

The following sorts have not been heretofore described in our bulletins:

Black Valentine.—The plants are of moderate growth and quite badly affected with rust. The pods are longer than the common Red Valentine and not curved; light green in color, tender and the quality is of the best. Scarcely so productive as some other sorts of the same season.

Cream Valentine.—Plants of vigorous, healthy growth. Pods longer, darker green, more curved, round and remain much longer in edible condition than Black Valentine, though the quality is not so good. Productive. A good, early, green-podded sort.

First in Market.—Plants of rather small growth and rusted badly. Pods long, green, curved and flattened. The variety is very slow to form beans in the pods and so it has a long edible season. It is early, but scarcely so productive as the Valentine class.

Improved Goddard.—This is an excellent sort to use as a green-shelled bean, as the beans are large, handsome in appearance and of fine quality.

Union White Valentine.—This variety has been grown for two seasons and has been very unproductive.

Vineless Marrow.—This is a field sort that is strong and healthy in plant growth and quite free from runners. The beans are extra large and fine in quality. A most excellent baking sort.

Byer's One Bean.—Plants of healthy, vigorous growth, very branching and productive. The pods are 5–6 inches long, round, nearly straight, green in color, very brittle and fine in quality. The plants are very productive and have a long season of bearing.

It is a valuable sort for the home garden or market.

Of the older sorts that have been grown for several seasons, some of which are omitted from the above table, *Cylinder Black Wax*, *Flageolet Victoria* and *Saddle-back Wax*, among the yellow-podded sorts, and *Red Valentine* and *Stringless Green Pod* among the green-podded, are worthy of mention as sorts of high excellence.

SUMMARY OF VARIETIES.

The following wax sorts have given the best satisfaction here:

Cylinder Black Wax, *Flageolet Victoria*, and *Golden Wax.*

Among the better green-podded varieties are: *Red Valentine, Cream Valentine, Stringless Green Pod*, and *Byer's One Bean.*

Improved Goddard as a shell bean would give good satisfaction.

POLE BEANS.

The cold, wet weather of June was very injurious to the seed of the pole varieties of beans planted, and it was almost impossible to get a good stand of plants. The frost of September 20 killed several sorts before they had matured edible pods or beans. For these reasons we have not attempted to tabulate the varieties grown the past season.

The following sorts matured sufficiently for partial notes to be taken:

Golden Lima.—Plants do not grow very high, but make a bushy growth at the bottom where a large crop of pods is borne. Very few pods had beans of edible size at time of frost. The beans were green in color and had not yet attained the rich golden claimed for them.

Mammoth Podded Horticultural.—Plants are of low, bushy growth. Pods dark green, streaked with carmine. But few pods had edible beans at time of frost.

Mastiff.—Plants of very strong growth and very productive. Pods straight, 6–8 inches long, broad, golden yellow in color, fleshy, and excellent in quality. This variety matured a fair proportion of pods before frost. It is an excellent wax pole bean.

Powell's Prolific.—Plants are very vigorous, growing to the top of the poles 8 to 9 feet high, and very prolific with pods from bottom to top of vines. Pods 5 to 6 inches long, round, regular in form and light green in color. The pods are very handsome in appearance with solid flesh of the finest quality. The variety was edible September 7, and remained in condition a long time. Valuable for earliness, productiveness, fine quality, and handsome appearance.

Seibert's Early Lima.—Plants strong, growing to tops of poles and productive. Pods are large, broad and contain 3 to 4 large beans that are excellent in quality. Edible September 16. One of the earliest and most valuable of the pole limas.

BUSH LIMAS.

Henderson's was the only one of the bush limas to mature edible beans before the plants were killed by frost.

CUCUMBERS.

The cucumbers were planted June 9. The following table gives the relative productiveness, time of maturing, and size of the varieties planted:

Variety.	Seedsman	Productiveness.	Date of pickling size.	Date of slicing size.	Average weight of single fruit. Ounces.
Arlington White Spine	Vaughan	90	Aug. 5	Aug. 9	7
Astro	Leonard	40	" 6	" 11	9.5
Beauty	Childs	85	" 2	" 7	7.5
Choice	Landreth	88	July 29	" 3	8.5
Emerald	Livingston	75	Aug. 5	" 10	9.5
Fordhook	Burpee	90	" 6	" 11	9.75
Goliath	Vaughan	80	" 4	" 9	17
Green Prolific	Ferry	92	" 2	" 7	7.5
Hill's Forcing	Vaughan	90	" 7	" 12	11
Japanese Climbing	Maule	92	" 11	" 15	18
None Such	Salzer	83	" 5	" 10	11.5
Sixty Day	"	94	" 4	" 9	12
Westerfield Pickling	Ferry	95	July 25	July 31	9.5

NOTES ON VARIETIES.

White Spine (Arlington).—This type is the general favorite among growers and market men and is the sort most largely grown for table use.

Astro.—Plants of small growth and few fruits borne. Leaf stalk short and leaves thicker in texture than those of most sorts. Fruits 6–8 inches long, 2 inches in diameter, round with few very short black spines; color a dark green. Excellent in flavor, but not firm or crisp. Unproductive and undesirable among the better sorts.

Beauty.—Plants of good growth. Margins of leaves quite deeply cut and spiny. Fruits 4–5 inches long, 2–2½ inches in diameter and triangular. The color is dark green and the spines are few, short and white. The form of the fruits is too short and thick for early pickles or for slicing.

Choice.—Plants are of vigorous, healthy growth. Fruits 5–6 inches long, 1½ inches in diameter, somewhat curved, light green, nearly white in color, with short, stout, black spines The variety is early and the fruits are good form for pickling or slicing purposes. An excellent general sort.

Emerald, *Fordhook*, *Green Prolific* and *Hill's Forcing* are excellent sorts for pickling and for table use. Emerald remains a long time in condition before ripening.

Goliath.—A large fruiting sort, excellent for home use, but too large and irregular in form to sell well in market.

Japanese Climbing.—This variety has been grown for several seasons. While the vines have a tendency to climb, they do well grown in the ordinary way. It is not so early as some others, but the fruits are of good form, attractive in appearance, fine in quality, and the plants are productive. A most excellent sort for pickling or for table use.

None Such and *Sixty Day* are closely of *White Spine* type and are good sorts, but the *White Spine* is preferable because a standard variety.

Westerfield Pickling.—Plants of very strong growth, healthy and productive. Early. A most excellent pickling sort, also a good table variety if left to get of proper size.

SUMMARY OF VARIETIES.

For early pickles: *Russian.*

For early slicing and pickling: *Choice* and *Westerfield Pickling.*

As general sorts for table and market: *White Spine* and *Japanese Climbing.*

LETTUCE.

Grand Rapids, of the loose growing sorts, has given the best results in the forcing house and hot beds. This variety gives a greater weight of crop from a given space and is less susceptible to rot than any other of the reveral kinds tried.

Where there is a demand for a close heading variety, *Tennis Ball*, *Boston*, and *Rawson's Hot-House* are excellent sorts to grow. The heading varieties must bring a higher price per pound than the loose sorts to make their growing profitable.

Seed for the varieties grown out doors was sown in the forcing-house March 24th, and the plants were removed to open ground May 13th. The table below gives the data obtained from this planting.

Variety.	Seedsman.	Date of maturity.	Average weight of a single head.
All Seasons	Dreer	July 6	12 oz.
Asparagus	"	June 28	13 oz.
Belmont	"	" 24	4 oz.
Big Boston	"	" 27	9 oz.
Brown Dutch	Ferry	July 2	11 oz.
Brown and Gold	Vaughan	" 5	9½ oz.
Cos	Burpee	" 3	1 lb 10 oz.
Defiance	Vaughan	" 2	9 oz.
Denver Market	Ferry	" 2	14 oz.
Half Century	Childs	" 2	15 oz.
Imperial	Vick	June 25	12 oz.
Italian Ice	Burpee	July 2	15 oz.
Landreth Earliest	Landreth	" 2	1 lb. 2 oz.
Mammoth Cabbage Head	Vaughan	June 29	1 lb. 3 oz.
Market Gardener's Detroit Forcing	Ferry	July 6	13 oz.
Mignonette	Henderson	" 1	4½ oz.
Morse	Burpee	June 30	1 lb. 2 oz.
Ninety and Nine	Vaughan	" 24	4 oz.
Premium Cabbage	Vick	" 30	8½ oz.
Rawson's Hot House	Vaughan	" 21	4 oz.
Sensation	Johnson and Stokes	" 30	3 oz.
Simpson's Curled	Ferry	July 5	1 lb. 5 oz.
Sumatra	Landreth	" 2	13½ oz.
Treasure	Johnson and Stokes	" 5	13 oz.
Wonderful	Dreer	" 2	1 lb. 8 oz.

NOTES ON VARIETIES.

Asparagus.—A *Cos* variety growing from 14–18 inches high. The leaves are very narrow. It makes too little growth in the center to be a desirable sort for tying up and blanching.

All Seasons.—Forms a rather close head from 12 to 15 inches in diameter. The outer leaves are large, round and smooth in general outline and of a dark green color. The inner leaves are of a rich, golden yellow color, tender and of good quality. The variety is well adapted to out door culture, as it stands heat well and is slow in forming a seed-stalk.

Belmont, *Boston*, *Denver Market*, *Rawson's Hot House* and *Sensation* are desirable sorts for the forcing-house or hot-bed, but give little satisfaction grown as out door varieties.

Brown Dutch.—Forms a close, compact head from 8 to 10 inches in diameter. The inner leaves are of a light yellowish green, tender and of very fine quality. An excellent dark-colored sort and it stands heat well.

Brown and Gold.—This sort resembles the preceding, but the leaves are more crinkled, the heads smaller and have fewer outer loose leaves. It is a little later than *Brown Dutch* and scarcely as good a variety.

Defiance.—This variety forms a close head which is tender but not of very good quality. The heads are too small and the sort is not so desirable as some of the larger growing kinds.

Half Century and *Treasure.*—These two sorts are very similar in appearance, though the heads of the *Half Century* are a little larger in size and more uniformly developed. The type is closely like *Brown Dutch* in leaf and habit of growth, but the leaves are lighter green in color and the heads closer and more compact. They are excellent sorts.

Imperial.—This was the first of the large growing sorts to mature heads. Heads 10 to 12 inches in diameter, light green in color, very tender and the quality is good. Valuable for earliness and good quality.

Italian Ice.—Forms a loose but not open head. It is a large growing sort and the tenderness and fine quality of the inner leaves is very marked. It sends up a seed-stalk very quickly. A fine sort for garden growing.

Landreth Earliest.—It forms a loose, open head that can be cut for use as soon as it has reached sufficient size. If allowed to mature, the heads are large and of fine texture and quality. A valuable large-growing sort. It is also a good variety to grow in the frames or forcing-house.

Mammoth Cabbage Head.—A large-growing sort forming a rather loose head. The leaves are quite smooth and regular in outline and the head is, perhaps, not so attractive in appearance as some of the more crinkled sorts. It is very tender and of fine quality. The variety soon goes to seed.

Ninety and Nine.—A lettuce of the *Tennis Ball* type but a poorer grower. A good forcing sort, but of little value out doors.

Simpson's Curled.—An old sort but one of the best grown. It is a little later in season than some others, but the large heads, fine appearance and good quality of this variety make it well worthy of a place in every garden.

Sumatra Curled.—Appears to be identical with *Denver Market.*

Premium Cabbage.—A variety of the *Tennis Ball* type but a somewhat larger grower and a little later in maturing.

Wonderful.—Forms a very large head, 15 to 17 inches in diameter and quite firm. The outer leaves are large, dark green, much waved and crinkled. The inner leaves are of a rich, golden yellow color, very tender and of fine quality. It remains a long time in condition before sending up a seed-stalk. A very fine variety.

SUMMARY OF VARIETIES

For forcing purposes, *Grand Rapids* of the loose-growing and *Tennis Ball* or *Rawson's Hot House* of the cabbage-heading sorts, have given the most satisfactory results

All Seasons, *Half Century*, *Landreth Earliest*, *Italian Ice*, *Simpson's Curled* and *Wonderful* are recommended for out-door growing.

PEPPERS.

Peppers are not commonly grown in the kitchen garden, possibly because their uses are not better known or their culture considered difficult. The seed should be sown in boxes in the house, or, preferably, in a frame out-doors, from the middle to the last of March. The plants should not be set out until all danger from frost is over. The varieties are quite different in size, form and number of fruits produced and in the time of ripening.

The following notes may aid the grower in selecting the varieties best suited to their needs:

Cardinal.—The fruits are 6 to 8 inches long, 1 inch in diameter at base and tapering. The variety is of early maturity and a rich, dark red color, but the fruits are so curved and twisted as to be unattractive in appearance.

Cayenne Red.—Somewhat similar to preceding, but fruits are smaller and shorter and a lighter red in color. The plants are very productive and the fruits very sharp in flavor.

Cherry.—This variety bears fruits that are round and about one inch in diameter. The plants are ornamental but the fruits are of little value.

Coral Gem Bouquet.—The fruits are one inch long and ½ inch in diameter. The plants have finely cut foliage and are thickly set with the small fruits making a very ornamental plant. This is the sort usually grown for small peppers. It is early and usually matures the fruits before frost comes.

Elephant's Trunk.—This variety bears long, large, irregular fruits that usually do not ripen before frost.

Golden Dawn.—The plants are productive and the fruits regular in form, large and of a rich golden yellow color. A desirable yellow sort.

Kaleidoscope.—The fruits are small, ridged and of little value. As an ornamental plant, because of the constantly changing colors of the fruits borne, it has a place.

Large Bell.—This is the sort usually grown for commercial purposes. The fruits are 3 to 4 inches long and 2 to 3 inches in diameter, quite smooth and regular in form and mild in flavor. The best sort for general cultivation.

Ruby King.—The fruits are much larger in size than the *Large Bell*, but not so many are borne and the variety is later in ripening.

TOMATOES.

The seed was sown in the forcing-house, March 19. The seedlings were transplanted April 4, and the plants set out in the field June 4. The plants made a good growth early in the season but did not bear one-half the usual crop of fruit. While this failure in crop may be due, in part, to the frequent rains occurring when the fruits were setting, the greater loss was caused by the fungus *Septoria Lycopersici.* This disease attacks the leaves and stems, causing the foliage to dry up and drop off, thus stopping further development of the fruit. The disease is new to this country and promises to be very destructive to the tomato crop. Some varieties seem to be more susceptible to attacks of the fungus than are others. It is probable that Bordeaux mixture will be found a remedy. The damaging nature of the disease was not known until late in the season and, although Bordeaux was then applied, it did little to prevent the loss in crop. Next season, earlier and more thorough treatment will be undertaken to control the disease.

In the table below will be found the date of first fruit ripening; the number and weight of fruits produced on one plant to September 3, and in the next column the total crop of ripe fruit borne on the same plant during the season. The average weight of a single ripe fruit is given, also the amount of green fruit on the plant when it was killed by frost (September 21). By dividing the crop into the two periods, the earliness of the varieties is more readily determined and a better index of value given than if the total crop produced was reported in one column.

The *(c)* following the seedsman's name in the table indicates that the variety has been grown one year at the College and seed saved from that planting for the present test.

TOMATOES.

Variety.	Seedsman.	Date of first ripening	Fruit ripe Sept. 3.			Fruit ripe Sept. 20.			Average weight of a single ripe fruit.—Ounces.	Weight of green fruit on plant at time of frost.	
			No.	Wt.		No.	Wt.				
				lbs.	oz.		lbs.	oz.		lbs.	oz.
Acme	Vaughan (*c*)	Aug. 8	14	5	6	28	11	2	6.35	9	3
Advance	College	" 11	75	13	3	177	26	1	2.46	11	14
Alexander	Moore (*c*)	" 19	19	3	12	74	16	10	3.59	12	8
Atlantic	Buckbee(*c*)	" 10	82	20	15	100	25	7	4.47	4	..
B. B.	Johnson & Stokes(*c*)	" 23	1	..	7	25	10	8	6.72	30	11
Beauty	Vaughan (*c*)	" 15	77	21	0	128	37	5	4.19	8	12
Brandywine	College	" 19							5.90		
Bright and Early	Dreer(*c*)	" 21	19	2	10	122	19	5	2.53	18	7
Buckeye State	Livingston	" 29							7.25		
Chemin	Thorburn(*c*)	" 26							4.58		
Conqueror	" (*c*)	" 10							3.50		
Crimson Cushion	Henderson (*c*)	" 23							7.62		
Criterion	Vick(*c*)	" 21							3.00		
Cross Bred	Landreth(*c*)	" 29							5.90		
Cross No. 3	Va. Agr'l College(*c*)	" 16							7.70		
Daybreak	Dreer(*c*)	Sept. 2	1	..	4	10	2	15	4.70	15	12
Democrat	Thorburn(*c*)	Aug. 26	3	1	6	10	4	9	7.30	12	..
Diadem	Childs	" 23	1	..	6	17	6	6	6.00	16	14
Dwarf Aristocrat	Buckbee(*c*)	" 17	5	1	11	20	5	8	4.40	7	8
Dwarf Champion	Vaughan (*c*)	" 19	5	..	15	14	2	15	3.35	4	8
Earliest (Select Early)	College	" 7	103	14	2	138	18	1	2.09	1	3
Earliest (Round)	"	" 9	58	11	10	108	21	15	3.25	5	..
Earliest (Oblong)	"	" 7	48	8	15	74	13	4	2.88	5	1
Favorite	Vaughan (*c*)	" 20	4	1	14	14	6	10	7.57	13	..
Ferris Wheel	College	" 26							7.25		
Fiji		" 23	14	4	1	30	8	12	7.66	5	..
Fordhook	Vaughan(*c*)	" 26	8	2	3	16	5	..	5.00	15	..
Fortune	Johnson & Stokes(*c*)	" 19	13	4	14	41	16	7	6.16	15	14
Golden Jubilee	Childs(*c*)	" 20							9.00		
Golden Queen	Vaughan(*c*)	" 20	1	..	5	14	4	2	4.71	26	10
Honor Bright	Livingston	" 29	43	10	12	51	12	7	3.90	15	12
Hybrid No. 1	Landreth	" 17							4.42		
Hybrid No. 4	"	" 22							4.85		
Hybrid No. 22	"	" 27							3.66		
Hybrid No. 25	"	" 23							3.00		
Hybrid No. 50	"	" 19							4.25		
Ignotum	College	" 21	6	3	5	19	7	3	6.05		
Imperial	Maule(*c*)	" 19	13	4	8	31	10	11	5.51	13	6
Ivory Ball	Landreth (*c*)	" 21							1.28		
Jersey	"	" 23	8	1	8	50	11	2	3.56	20	..
La Crosse	College	" 16	17	4	7	32	8	9	4.28	6	9
Large Red	"	" 19							4.80		
Leader	Vick	" 9	68	14	13	110	23	9	3.43	5	11
Lemon Blush	Thorburn (*c*)	" 23							5.83		
Lemon Yellow	Livingston	" 23	5	1	6	25	5	5	3.40	6	..
Lorillard	Dreer	" 23							6.30		
Mayflower	Burpee	" 23	10	3	9	39	12	13	5.23	21	8
McCollum Hybrid	College	" 23	1	..	5	9	3	5	5.76	21	..
Miner	Miner(*c*)	" 29	5	2	2	8	3	11	7.37	6	5
Minnesota	Dreer	" 17	39	7	1	89	17	10	3.17	12	3
Money Maker	Landreth(*c*)	" 21							5.30		
Novelty 22	" (*c*)	" 19							2.75		
Northern Light	College	" 29							10.12		
Number 81		" 29							4.00		
Number 105	Johnson & Stokes(*c*)	" 23	13	5	5	20	7	13	6.25	16	..
Optimus	College	" 21	14	3	5	25	7	3	4.60	24	8
Perfection	Vaughan (*c*)	" 23							7.95		
Ponderosa	Henderson(*c*)	" 21							7.50		
Potato-leaf	College	" 27							7.24		
Potato-leaf Ignotum	"	" 19	21	9	12	34	16	15	7.97	8	4

TOMATOES.—*Concluded.*

Variety.	Seedsman.	Date of first ripening	Fruit ripe Sept. 3.		Fruit ripe Sept. 20.		Average weight of a single ripe fruit.—Ounces.	Weight of green fruit on plant at time of frost.
			No.	Wt.	No.	Wt.		
				lbs. oz.		lbs. oz.		lbs. oz.
Potato-leaf Ignotum (Sport)	College	Aug. 21	16	4 7	29	11 10	4.49	4 3
Prelude	Dreer	" 16	------	------	------	------	2.12	------
Purple Cross	Landreth (*c*)	" 23	------	------	------	------	5.60	------
Puritan	Thorburn (*c*)	" 22	------	------	------	------	6.10	------
Ruby	Henderson (*c*)	" 16	------	------	------	------	3.41	------
Seedling	West Va. Station (*c*)	" 29	------	------	------	------	8.33	------
Shah	College	" 27	------	------	------	------	7.20	------
Stone	Vaughan (*c*)	" 27	------	------	------	------	6.90	------
Ten Ton	Landreth (*c*)	" 23	18	5 5	38	11 --	4.62	------
Terra Cotta	Thorburn (*c*)	" 23	23	6 6	40	10 1	4.02	------
Thorburn	" (*c*)	" 29	------	------	------	------	7.80	------
Tree	Buckbee (*c*)	" 29	------	------	------	------	4.75	------
Turner Hybrid	Vaughan (*c*)	" 27	1	-- 8	10	4 7	7.10	------
Trophy	" (*c*)	" 22	7	2 14	25	9 11	7.05	------
Virginia Corker	Landreth (*c*)	" 27	------	------	------	------	8.75	------
Volunteer	Vaughan (*c*)	" 23	------	------	------	------	6.12	------
Yellow Cherry	" (*c*)	" 19	------	------	------	------	------	------
Yellow Egyptian	------	" 19	------	------	------	------	3.70	------
Yellow Peach	Vaughan (*c*)	" 21	------	------	------	------	1.87	------
Yellow Plum	" (*c*)	" 16	------	------	------	------	------	------

NOTES ON VARIETIES.

The following sorts, most of them new, have not been previously described in our bulletins:

Diadem.—The plants were of strong growth and quite free from disease. The fruits are large, round, regular, somewhat flattened. Color a rich red with golden yellow streaks running from base to apex. Unique and handsome in appearance. The flesh is bright in color and of very good quality.

Fiji.—The plant is of healthy, stout, tree growth, closely like *Dwarf Champion* and the fruits closely resemble those of that variety, but are larger in size and darker purple in color. *Dwarf Champion,* while ripening a few fruits early, is rather late to ripen the bulk of the crop. *Fiji* was a few days later in ripening first fruits, but produced a much larger crop before frost than did *Dwarf Champion,* and as the fruits are larger it seems preferable to that variety for the grower.

Honor Bright.—Plants of strong, healthy growth; leaflets small, light yellowish green; leaf-stalk and stems yellow. Distinct in plant appearance, Fruits of medium size, round, flattened, regular form. The color is light green, then white, changing to yellow and finally becoming a rich red when fully ripe. The flesh is very solid, of high quality, and firm, and the variety would be excellent for shipping.

Lemon Yellow.—Plant of *Dwarf Champion* type, though larger and stouter in growth. Fruit round, somewhat elongated in form; color a bright, clear yellow; skin thin; cells quite large, open. Of fair quality.

Mayflower.—Closely resembles Ignotum in plant, but the fruits are scarcely so large and the color is darker red. The tomatoes grow in clusters, color very evenly, do not crack and are of best quality.

Number 81.—Plants are of weak growth and badly defoliated by fungus. Fruits are of medium size, flattened, often quite irregular and yellow in color. The flesh is solid but poor in quality. Some other yellow sorts have larger fruits and are better in quality.

Yellow Egyptian.—Plants of straggling growth and finely cut foliage. Very productive, but the fruits are too small for a yellow sort when there are varieties that have much larger tomatoes.

The following sorts have been grown for two or more seasons:

Acme.—The plants of this well-known variety were of healthy growth and productive. The fruits are large, regular in form and of a popular color. One of the best sorts for the general grower.

Advance.—We have grown this variety for many seasons and have found no better second early sort. The variety is very productive and while the fruits are not large, they are very regular in form and even in ripening. This season the variety was badly attacked by the fungus.

Beauty, *Ignotum*, *Optimus* and *Perfection* are among the best of the large red fruited sorts. *Beauty* and *Optimus* suffered more from fungous attack than did *Ignotum* and *Perfection.*

Dwarf Aristocrat seems preferable to *Dwarf Champion* on account of the larger fruits and the earlier ripening of the bulk of the crop. The fruits, however, are red and have not the dark purple color of *Dwarf Champion.*

Earliest.—We have made a specialty of this variety for several seasons, endeavoring to improve the size and regularity of the fruits without losing anything in earliness. Plants were grown from a strain of seed selected with special reference to early fruiting. Also an attempt will be made to fix a more regular type of oblong and round fruiting sorts. By reference to the table, it will be seen that the early strain produced earlier fruits, but the tomatoes were smaller in size. Earliest has a place to a limited extent, as a first ripening sort. The variety suffered more from *Septoria Lycopersici* than any other sort in the field. *Atlantic*, *Leader* and *Ruby* are much the same in form, but have larger fruits and are a few days later in ripening.

Potato-leaf Ignotum.—Plants of strong growth though somewhat defoliated by fungus. The fruits were larger, and earlier in ripening and the plants more productive than either *Ignotum* or *Potato-leaf.* A very desirable sort for the general grower.

Terra Cotta.—A variety having a thin, velvety skin and flesh of a rich red color and excellent in quality. A fine sort for home use.

SUMMARY OF VARIETIES.

Vaughan's Earliest is one of the best early ripening sorts. *Atlantic*, *Leader*, or *Ruby* closely follow *Earliest* in season and bear larger fruits.

Advance is a most excellent early sort bearing smooth fruits.

Potato-leaf Ignotum, *Acme*, *Beauty*, *Ignotum*, *Perfection* and *Optimus* are excellent sorts for general crop.

Golden Queen is one of the best yellow sorts.

Miner and *Ponderosa* bear large fruits that are very solid and of good quality, but late in ripening.

CABBAGES.

The test of cabbages included a selection from last year's list of twelve early, fourteen medium, and seventeen late varieties.

The seed of the early sorts was sown in boxes, in the forcing house, March 23. The medium varieties were sown April 6. As soon as the plants reached proper size, they were pricked out into flats and remained there until May 17th and 18th, when they were planted in the field.

The late seed was sown in a cold frame, May 18. The young plants were thinned to the proper distance and remained in the bed until they were transplanted in the field, June 26.

Variety.	Seedsman.	Season.	Date.		No. of days from transplanting to maturity.	Number of plants headed.	Total weight.	Average weight.
			First mature head.	Market maturity.				
All Head	Burpee	Early	Aug. 2	Aug. 12	87	9	31.5	3.5
All Head	Vaughan	"	" 2	" 12	87	6	24	4
Bullock Heart	Landreth	"	" 1	" 10	85	11	33	3
Early Spring	Vaughan	"	" 2	" 10	85	14	42	3
Early York	King	"	" 2	" 8	83	7	17	2.43
Express	Vaughan	"	" 3	" 14	89	10	30	3
Henderson's Summer	"	"	July 27	" 8	81	10	30	3
Landreth's Earliest	Landreth	"	" 28	" 10	82	5	16	3.2
Reedland Drumhead	"	"	" 26	" 12	80	11	44	4
St. John's Day	Henderson	"	" 28	" 10	82	12	30	2.5
Wakefield, Early Jersey	Vaughan	"	Aug. 2	" 10	87	9	36	4
Winnigstadt	Ferry	"	" 4	" 16	89	8	20	2.5
All the Year Round	Landreth	Medium	" 10	" 19	93	3	9	3
Autumn King	Henderson	"	" 10	" 19	93	10	40	4
Ball Head	Burpee	"	" 19	" 23	97	9	30	3.33
Braunschweiger	Salzer	"	" 19	" 24	98	4	14	3.5
Long Island	Brill	"	" 15	" 20	94	6	22	3.66
Lupton	Burpee	"	" 16	" 20	94	1	--------	5.5
Mid-Summer	Maule	"	" 14	" 20	94	11	52	4.72
Salzer's Ideal	Salzer	"	" 2	" 10	84	14	94	6.71
Short Stem	Henderson	"	" 10	" 20	94	6	28	4.6
Succession	"	"	" 12	" 20	94	8	47	5.62
Sugar Head	Vaughan	"	" 16	" 26	100	9	33	3.66
Sure Head	Burpee	"	" 14	" 25	99	9	55	6.1
Vandergaw	Vaughan	"	" 2	" 14	88	6	18	3
World Beater	Burpee	"	" 12	" 20	94	5	20	4
Champion Drumhead	King	Late	Oct. 1	*Nov. 10	97	8	71.68	8.71
Colossus	Salzer	"	" 1	" 10	97	25	258.45	10.39
Danish Ball	Burpee	"	Sept. 28	" 10	94	22	258.5	11.75
Diamond Winter	Gregory	"	Oct. 4	" 10	101	23	184.69	8.03
Dutch Winter	Vaughan	"	" 10	" 10	106	23	114.31	4.97
Flat Dutch	Ferry	"	" 15	" 10	111	22	121	5.5
Hollander	Buckbee	"	" 1	" 10	97	20	137.5	6.87
Ideal Winter		"	" 2	" 10	98	18	108.5	6.03
Late Mountain	Landreth	"	" 15	" 10	111	10	71	7.1
Mammoth Rock	Johnson & Stokes	"	" 14	" 10	110	21	102	4.85
Mammoth Rock Head	" " "	"	Sept. 29	" 10	96	19	90.5	4.16
N. B. G. & Co. 100 Weight	N. B. G. & Co.	"	Oct. 4	" 10	100	15	87	5.8
New Rock Head	Johnson & Stokes	"	" 2	" 10	98	25	159.15	6.39
Premium Flat Dutch	Ferry	"	" 8	" 10	104	24	131	5.45
Red Drumhead	"	"	" 4	" 10	100	18	114.5	6.37
Stone Mason	Vaughan	"	Sept. 30	" 10	95	19	142.7	7.3
Warren	Gregory	"	Oct. 1	" 10	97	21	118.86	5.66

* Date harvested.

The early and medium varieties were watered by surface irrigation, when the heads were about half grown, and again ten days later. They were planted in rows three and one-half feet apart using twenty plants of each variety, the plants having a space of twenty inches in the row. In the late plot, twenty-five plants were used, and water was applied several times.

The cabbage maggot (*Phorbia Brassicæ*) attacked the early and medium varieties, and destroyed many of the plants.

The tables include the varieties that were most promising last year and proved true to name.

A collection of the best early varieties might include: Henderson's *Early Summer*, *Wakefield*, *Early Drumhead*, *All Head* and *Early York*, all of which produce large, well formed, solid heads of fine quality.

Among the best medium varieties, some of which produce heads equal to the winter sorts, are: *Autumn King*, *Lupton*, *Mid-Summer*, *Succession* and *World Beater*.

NOTES ON LATE VARIETIES.

Champion Drumhead, from John K. King, Coggeshall, Essex, England, is of the Drumhead type, but the seed was slightly mixed as a few of the plants produced large, loose, flabby heads.

The typical heads were broad, deep and flat, tender, crisp, and very white. It is a strong, rank grower, and has a large amount of superfluous foliage covered with a greenish-purple bloom; stem, short and stout. If true to type, it would be of value as a late variety.

Colossus, sent out by Salzer, is a strong growing and sure heading variety that has gained prominence on account of its large, firm, crisp heads, and excellent keeping qualities.

Danish Ball, from Burpee, a strong plant, true to type. The heads are of good size, round, solid, crisp and tender. The stem is of medium length, rather slender and weak; foliage thick, leathery, covered with a light blue bloom, and sets closely around the heads.

A good variety for a firm, round medium sized head, possessing rare keeping qualities.

Diamond Winter, one of Gregory's specialties, produced very large, solid heads of the *Flat Dutch* type. The plants were strong; foliage light green with bluish white bloom. Heads broad, flat, true to type and were well covered with leaves; stem short, stout.

Dutch Winter from Vaughan, and *Buckbee's Hollander* are nearly identical, except that *Dutch Winter* set a few more heads.

The plants were strong, making a rank growth; heads small, round, very hard, deeply set in an extra amount of leaves; foliage thick, greenish purple covered with a blue white bloom; stem short and stout. Very much like the *Danish Ball*. All three varieties possess qualities that make them desirable for winter use.

Flat Dutch and *Premium Flat Dutch* from D. M. Ferry & Co. are standard late varieties with which other sorts are compared.

The plants are hardy; heads large, broad, flat, and deep, of a bluish green color and when cut open, are crisp and tender, and have a pleasant flavor. The leaves are thick, of bright green color and covered with light blue bloom; stem short, stout.

These varieties should be grown in every home garden, owing to their hardiness and their edible and keeping qualities.

Ideal Winter is one of A. W. Livingston's Sons' novelties that proved to be of value either for immediate use, or keeping purposes.

The plants seemed to be strong growers, not easily affected by dry weather. The heads were medium to large, true to the type of the *Drumhead*, broad, flat, deep, very crisp and tender; foliage thick, light green with a purple border. The superfluous leaves are numerous. A variety worthy of trial.

Late Mountain, Landreth, is a strong growing, short-stemmed variety that developed rather soft, medium-sized heads, covered with a large amount of extra foliage.

The leaves are thick, glaucous, and of a dark green color; stems short and stout.

Mammoth Rock and *Mammoth Rock Head*, both from Johnson & Stokes, showed no marked difference. They produced strong-growing plants with short, stout stems.

The heads were of good size, round, solid, of deep red color, tender and of fine flavor; foliage thick, covering the heads; color deep purple with light blue bloom, making them very attractive in the garden.

N. B. G. & Co. Hundred Weight, introduced by Northrup, Braslan & Goodwin Co., is a very large cabbage of the *Flat Dutch* type, but has a tendency to form rather loose heads. The quality is good and if grown firm they are valuable.

New Rock Head, one of Johnson & Stokes' recent introductions, proved to be one of the surest headers in the test.

The plants are very strong, vigorous growers, with a deep root growth. The heads are large, broad, flat, very solid, and the quality is hard to excel; foliage is thick, light green with blue white bloom and covers the head. The leaves set low on the stalk leaving a short, stout stem. A variety of much promise.

Red Drumhead, sent out by Ferry, proved to be one of the best red varieties. The heads are medium to large, firm, of good quality and deep red in color. A marked difference between this and the other red sorts, was in the shape of the heads, which are of *Drumhead* type, while most of the other sorts are round.

Stone Mason, Vaughan, possesses qualities that make it a desirable sort for the gardener or home grower.

The plants are strong and develop a large per cent of heads. The heads are of good size, firm, crisp and tender, with a mild flavor; foliage thick, light green, with blue white bloom, branching low from a short, stout stem.

Warren, from J. J. H. Gregory & Son, is of the *Drumhead* type and proved to be very true.

The heads are deep, solid, and of fine quality; foliage light colored, tinted with purple near the edges, thick, leathery, glaucous and well lapped over the head; very few are superfluous. The stem is short, stout, holding the head erect.

INSECTS AND DISEASES OF THE CABBAGE.

The growing of cabbages, cauliflower and other vegetables of this family is becoming somewhat uncertain, owing to the prevalence of various insects and diseases, which attack and in many locations completely destroy them.

For several years the cabbage maggot (*Phorbia Brassicae*) has seriously affected the growth of the young plants in this vicinity, and has continued its depredations after the plants are placed in the field. As a preventive, care should be taken that fresh soil is used for growing the plants, and that the land on which the plants are set is at some distance from that on which cabbages, onions, radishes, or turnips were grown the previous year.

A good way to combat this enemy is to mix a small quantity (a tablespoonful) of kerosene or turpentine with a peck of wood ashes and scatter over the ground near the plants; this prevents the mature insect, which is a small brown fly, from depositing its eggs upon the stems of the plants.

Kerosene emulsion and bi-sulphide of carbon have been used very successfully, and some growers advocate the placing of a circle of tarred paper around the plant, leaving it until the danger limit is passed.

The Club root, sometimes called club foot, has been for many years, a troublesome disease on the cabbage as well as on the turnip in the Eastern States and has appeared in several places in Michigan. It attacks the plants at the root and causes large swellings, which both absorb the nutriment of the plant and girdle the stem, thus checking the growth and causing it to turn yellow and die.

One strong symptom of this trouble, is the rank, disagreeable odor of decay which it gives the roots. There has been no remedy discovered for this disease, but to avoid the growing of cabbage, in succession on the same soil, and the use of the manure that contains cabbage refuse will keep it in check, and generally prevent it altogether.

In the vicinity of Racine, Wisconsin, a bacterial disease of the cabbage developed itself several years ago, and in 1896, caused heavy losses to the growers. It also injured crops in other localities.

This year it caused more trouble on the cauliflower than upon the cabbage, *Kale* or *Kohl Rabi.* The symptoms of the disease are small yellow spots, which appear on the leaves and spread over the entire surface of the leaves. The leaves droop, and a black rot soon destroys the heads.

This disease may be carried by the seed from one section to another, and when once established, the successful growing of plants of the cabbage family is nearly impossible. The destruction of all diseased plants as soon as found by burning them, seems to be the only way to hold it in check.

Cabbages are often much injured by so-called cabbage worms which feed upon the leaves, and if undisturbed may destroy the heads. They often appear early in the season before the heads have begun to form and at that time can be readily killed by the use of Paris green, or other arsenites, at the rate of one ounce to fifteen gallons of water, or with plaster or flour at the rate of one pound to one hundred. Care should be taken not to use these poisons after the heads have formed, as the danger increases as the time of ripening approaches. Should the worms appear late in the season, pyrethrum or saltpetre at the rate of a teaspoonful to a gallon of water can be used, with good results and without danger. The worm can also be destroyed by pouring hot water upon the leaves. Especially in dry seasons cabbages are often much injured by lice which may appear in immense numbers upon the leaves. As a rule, they are on the under side and in the folds of the leaves so that it is difficult to reach them with an insecticide. The prompt and thorough use of kerosene emulsion, or strong tobacco water, will aid in holding them in check, but it will be even more satisfactory to so handle the crop that the lice will not be likely to appear. When from any cause the plants are checked in their growth, we may expect the rapid development of the lice, and the danger can be lessened if land that is not likely to suffer in time of drought is used, especially for the late varieties, and if frequent shallow cultivation is given.

CAULIFLOWERS.

Seven varieties comprised the test in cauliflowers.

The seed and plants were handled the same as the cabbage varieties in the forcing house, and twenty-five plants of each variety were planted in the field June twenty-fifth.

Algiers from Henderson, produced some large, solid heads of fine quality, being tender and of mild flavor.

Salzer's *Blue Ribbon* was one of the first to mature well formed heads of good quality and seems to be worthy of further trial.

California Wonder, introduced by Vaughan, grew the largest plants in the test, but failed to develop heads. The hearts of the plants were a curled mass of broad, irregular leaves. Perhaps it would form heads where the season is a little longer.

Chief, one of Buckbee's introduction proved to be a valuable variety. It is early and grows a solid, compact crisp head on a short stalk. The leaves are numerous and have an upright growth which covers the head and protects it from the sun, thus leaving it a pure white, without being blanched by tying the leaves together, as is necessary with most of the other varieties.

Erfurt, sent out by Vaughan, is a standard early variety and matures good sized heads of fine quality.

Erfurt and *Puget Sound* sent by H. A. March, Fidalgo, Washington, proved to be much alike. They are strong growing plants and produced a much larger per cent of heads than any other sort. The heads are even and symmetrical and the quality is up to the standard. They should be classed among the best.

The same varieties of *Kale* and *Kohl Rabi* were grown as last year. The season was not as favorable for their growth but by the use of the irrigating system, equally as good plants were grown, and they were much relished by people familiar with their use.

Variety.	Seedsman.	Season.	Date.		Number of days from transplanting to maturity.	Number of plants headed.	Total weight.	Average weight.
			First mature heads.	Market maturity.				
Algiers	Henderson	Early	Aug. 30	Sept. 15	82	12	45.	3.75
Blue Ribbon	Salzer	Medium	Sept. 10	" 30	97	14	45.5	3.25
California Wonder	Vaughan	Late						
Chief	Buckbee	"	Sept. 25	Oct. 10	107	18	95.4	5.3
Erfurt, Dwarf	Vaughan	Early	Aug. 25	Sept. 15	82	15	60	4
Erfurt, Large	March	Late	Sept. 10	Oct. 1	98	23	126.5	5.5
Puget Sound	"	"	" 12	" 1	98	24	138	5.75

SWEET CORN.

The varieties of sweet corn numbered thirty-one and included most of the new kinds sent out by different seedsmen; but the majority are standard sorts that need no description to establish their value to the truck gardener, or their usefulness in the home garden.

The seed was planted May 26, in rows three and one-half feet apart, using five kernels for each hill. The cold, wet weather that followed, made germination slow and some of the seed rotted.

TABLE OF VARIETIES.

Number.	Variety.	No. of ears per square rod.	No. days from planting to edible maturity.	Height of stalks.—Feet.	Average. No. of ears per stalk.	Average. Length of ears.—Inches.	No. of rows of kernels per ear.	Length of kernels.—Inches.	Diameter of cob.—Inches.	Average weight of ears.—Ounces.
1	Adams	116	73	5.	.92	7.5	12	.375	1.	6.8
2	Bonanza	78	97	7.	.79	8.	12	.5	1.	9.1
3	Champion	50	84	6.	.65	8.	12	.375	1.	7.
4	Chicago Market	52	75	5.	.62	7.	12	.375	1.125	5.6
5	Columbus Market	75	92	7.	.78	8.5	14	.375	1.25	8.
6	Concord	62	78	5 to 6	.52	10.	12	.375	1.	8.
7	Cory. (Mammoth White)	95	72	4.5	.88	6.5	16	.43	1.	5.6
8	Country Gentleman	98	105	7.5	.87	7.5	18	.5	1.	6.9
9	Dawn	85	92	6.5	.58	7.	14	.3125	1.125	6.8
10	Early Sugar	102	78	6.	.64	8.	12	.375	1.	6.4
11	Egyptian	87	103	6 to 8	.64	9.	12	.5	1.	8.5
12	First of All	38	74	4 to 5	.53	6.5	10	.375	1.	4.8
13	Fordhook	92	70	5.	.75	7.	8	.5	1.	4.8
14	Fottler	71	76	4 to 5	.61	7.5	12	.375	1.	6.4
15	Giant	73	81	5 to 6	.6	9.	14	.43	1.25	8.8
16	Gold Coin	91	103	8.	.84	9.	14	.5625	1.125	9.
17	Hance	135	96	7.	.55	7.5	10	.375	.875	8.
18	Honey Dew	71	97	8.	.61	8.	12	.3125	1.	7.
19	La Crosse	83	71	5.	.7	7.5	8	.375	1.	6.
20	Landreth Market	111	84	6 to 7	.81	8.	10	.3125	1.	6.8
21	Landreth Sugar	95	96	8.	.69	9.	14	.375	1.125	8.
22	Leet	47	80	5.	.66	8.	10	.3125	1.25	8.
23	Mammoth	72	106	7 to 8	.85	9.5	14	.375	4.315	9.
24	New England	76	78	5 to 6	.58	8.	8	.3125	.875	5.6
25	Old Colony	76	97	6.5	.7	8.5	16	.43	1.25	8.
26	Pee and Kay	71	82	6.	.68	8.5	14	.3125	1.25	8.4
27	Quincy	104	73	5.	.81	7.5	12	.3125	1.125	6.4
28	Roslyn	128	94	7.	.68	9.5	12	.3125	1.125	7.1
29	Ruby	85	97	7.	.59	9.0	14	.3125	1.125	8.
30	Stowell	71	92	7.	.71	10.	16	.625	1.	8.5
31	Twenty Day	14	70	4.	.3	6.5	8	.3125	1.	5.6

The three varieties sent out by A. W. Livingston's Sons of Columbus, Ohio, proved to be particularly promising.

Columbus Market, grows a strong stalk well covered with long, broad foliage. The ears are symmetrical, maturing about the season of Stowell, and equal it in quality.

Giant, proved to be a very large early corn; ears of good length and well filled with broad kernels of large size and high quality.

Hance, a variety medium in season, developed some valuable points. It is a good grower, producing long ears; cob small, well covered with broad, white kernels, rich in sugar.

Twenty Day, a dwarf variety, sent out as a novelty by Salzer, matured the first ears, but they were very small and much injured by smut. Judging from this year's test, it seems valueless.

The standard sorts of sweet corn can be grouped into five classes, viz.: Extra Early, Early, Medium Early, Medium Late, and Late.

In the class of Extra Early varieties, can be placed *Fordhook*, *LaCrosse*, *Cory* (*Mam. White*), *Adams*, *Quincy*, and *First of All*, which mature in the order named. Each variety possesses qualities that make it of value, under certain special conditions.

In the "Early" class are *Chicago Market*, *Fottler*, *Concord* and *New England*, all of which are standard varieties.

The "Medium Early" group includes the first true sugar varieties, such as: *Leet*, *Giant*, *Pee and Kay*, *Champion*, *Landreth's Market* and *Columbus Market*, which together with those ripening a little later, such as *Stowell*, *Roslyn*, *Hance*, *Landreth Sugar*, *Honey Dew*, and *Ruby*, extend the season until the large late varieties ripen.

Among the "Late" varieties, are: *Egyptian*, *Gold Coin* and *Mammoth*, which produce ears of large size, but are of no better quality than some of the "Medium Late" sorts. *Country Gentleman* is a late maturing kind, of medium size and superior quality, making it one of the best varieties for home use.

PEAS, 1897.

LIST OF VARIETIES.

Number.	Variety.	Seedsman.	Per cent. grew.	Date. First blossom.	Date. Edible maturity.	No. of days from planting to edible maturity.	Length of edible maturity.—Days.	No. of peas in each pod.	Per cent of peas to total weight.
1	Advancer	Ferry	65	June 14	June 26	51	8	5-7	55
2	Alaska	"	70	" 12	" 28	53	8	4-8	51
3	Alpha	"	75	" 12	July 1	56	7	2-5	49
4	American Wonder	"	70	" 14	" 1	56	9	5-8	45
5	Asparagus	Burpee	65	July 1	" 22	77	7	5-12	28
6	Charmer	Vick	85	June 23	" 6	61	8	5-8	49
7	Champion of England	Ferry	95	" 24	" 4	59	10	6-7	52
8	Daisy	Burpee	85	" 22	" 5	60	10	4-7	48
9	Eclipse	Vaughan	85	" 12	June 29	54	7	4-7	51
10	Epicure's Delight	Salzer	95	" 17	July 4	59	8	5-9	35
11	First and Best	Ferry	90	" 12	June 24	49	6	5-7	52
12	Grant's Favorite	Burpee	90	July 1	July 16	71	12	5-7	51
13	Morning Star	Childs	90	June 13	June 28	53	8	4-8	45
14	Nott's Excelsior	Ferry	90	" 17	July 1	56	9	4-7	34
15	Orion	Leonard	80	" 22	" 5	60	8	4-7	38
16	Prolific	Livingston	95	" 26	" 10	65	7	4-8	48
17	Scorcher	Salzer	90	" 11	June 30	55	7	4-6	50
18	Startler	Buckbee	*						
19	Stratagem	Ferry	50	" 29	July 16	71	8	5-8	45
20	Surprise	Gregory	75	" 20	" 1	49	7	4-7	46
21	Tall Grey Sugar	Vaughan	85	July 1	" 22	77	9	5-8	50
22	Telephone	"	45	June 23	" 7	62	8	3-10	32

* Failed to grow.

The test of peas for 1897, was confined to the novelties and new varieties, together with some of the standard sorts for comparison. The plot selected was on the south side of the vegetable garden, directly west of the standpipe.

The seed was sown Wednesday, May 5, two inches apart in double drills about four inches deep, using twelve feet for each variety. The conditions of the soil and weather were such that a large per cent grew. The rains during the early part of the season were sufficient to promote a strong growth of vines, well set with pods; but the extremely hot weather the last of June and first of July, would have shortened the crops and seriously affected the yield, had not water been applied by our irrigating system, which greatly increased the length of the edible period.

The standard varieties noted are used as representative types of the different classes with which to compare the new sorts.

CLASS I.—Plants tall, averaging three to four feet, seeds white or cream colored; pods edible.

Tall Grey Sugar, sent out by Vaughan, was the sole representative of this class; a very tall growing variety with strong rank vines, very spreading. The pods are long, broad, very tender and sweet; used the same as string beans. The peas are large, plump, very tender, and rich flavored. If this variety was more prolific, it would be a desirable sort.

CLASS II.—Plants tall, averaging three to four feet; curved pods, white or cream colored seeds.

Champion of England, one of the older sorts, can be taken as a true standard for this class, as it is one of the best varieties for the home or market garden.

The additions to this class are:

Morning Star, from Childs, a tall growing variety, with very fine, branching vines; quite productive, pods well filled, with plump sweet peas of fine texture.

Prolific, sent out by Livingston, is an exceedingly strong grower and very productive, but seemed to be rather susceptible to mildew, as it was one of the two varieties that showed traces of it. The pods are long, broad, irregular in shape, and filled with peas of high quality. The blossoms are of a pink color and make it quite attractive. It promises to be of value as a late variety.

Surprise, from Gregory, seemed to be quite typical of its name as, sowed one week later than the other varieties, it made a very rapid growth and reached maturity sooner than several of the smaller sorts.

The vines are very slender and branching, and it dries quickly in hot weather, which shortens its edible period. The pods are regular in form, of good size, and are filled with tender, sugary peas.

Telephone, also belongs to this class, but it is an old variety much like *Champion of England*, except being a few days earlier and of shorter edible maturity.

Charmer, a new variety sent out by Vick. The plants are from three to five feet high, with light colored foliage; lacking in productiveness. Pods are long, slim, slightly curved, pointed at the apex, and fairly well filled with plump, sweet peas.

Grant's Favorite.—Introduced by Burpee.

The vines are tall, rank growers, with dense, dark colored foliage, not easily affected by dry weather. Stipules short, pods long, broad, nearly straight, blunt at the apex, and well filled with peas. The peas are plump, tender, and very rich in flavor.

This promises to be of especial value for the home garden, as the length of edible maturity is much prolonged by the vines still continuing to bloom when the first pods are edible.

CLASS III.—Half dwarf varieties, two to four feet high. Peas smooth or indented; white or cream; pods straight or nearly so. *Stratagem* will represent this class.

Alpha, from D. M. Ferry & Co., grew rather spindling vines that seemed to be rather easily affected by dry weather.

The pods were numerous, of good size and shape, but not well filled. The peas were fair size, plump, tender, and contained a medium amount of sugar.

Eclipse, introduced by Vaughan.

Vines are strong, of medium size, and well covered with dark-colored foliage. Pods are short, plump, and very even, nearly all maturing at once. Peas round, plump, tender and sweet.

Epicure's Delight, introduced by Salzer. A very quick growing variety, with medium-sized vines.

The vines are dark green in color, appear to be strong and hardy and produce a large amount of broad pods, tapering from the stipules to about the center, and blunt at the apex. Peas large, of irregular round shape, sweet and tender.

Orion grew medium sized, light colored vines well set with pods that contained comparatively few peas. The pods were pointed at both base and apex and contained a few peas of medium quality.

CLASS IV.—Vines dwarf; seeds green, bluish green, white or cream colored; seeds shriveled; pods straight or nearly so.

First and Best from Ferry, was the first to reach edible maturity. The vines were of medium size, strong growers, but began to die as soon as the peas reached edible maturity, thus shortening the length of their usefulness. Pods are plump, regular shape and well filled with large peas that seem to have a rather tough skin; flavor good. A good early variety, which can be taken as the type of this class.

Scorcher, received from Salzer, is an early quick grower, with straight pods of good size, well filled with peas of high quality. The vines are of medium size, branch close to the ground, and the well-filled pods are borne abundantly. Peas are of medium size, tender, and of good quality for an extra early variety.

POTATOES, 1897.

The experimental plot for potatoes was located on the north side of the garden; a part of it was used for potatoes in 1896, the balance being a turned under strawberry bed.

The soil is rather diversified, ranging from a black loam, mixed with quicksand to a light sand with a clay subsoil, but the plots were so arranged that the test was a fair one. Although the seed was treated with corrosive sublimate solution (1-2000), the crop of tubers showed more scab than last year, especially on the portion where potatoes had been previously grown. The weather furnished the proper conditions for the development of the scab germs, and had the seed not been thoroughly disinfected the loss would probably have been much greater.

A heavy coating of finely composted manure was plowed under in the fall and the land was replowed in the spring and finely pulverized with the Acme harrow and rolled, which placed the soil in a fine tilth for the young plants.

TABLES OF VARIETIES.—*Plot Planted May 11.*

Variety.	Date of maturity.		Yield per acre, bushels.			Average yield for 1896, 1897.	General average.	No. of years averaged.
	Edible.	Market.	Large.	Small.	Total.			
Acme	Aug. 5	Aug. 25	114.03	15.55	129.58	146.42	146.42	2
Algoma	“ 1	“ 25	62.2	36.28	98.30	--------	--------	1
Belle	“ 25	Sept. 14	150.31	31.1	181.41	176.52	176.52	2
Blush	“ 28	“ 2	62.2	31.1	93.3	--------	--------	1
Bovee (Dep't)	“ 24	“ 2	119.21	46.65	165.86	146.39	185.76	3
Bovee (Hend.)	“ 24	“ 6	93.3	36.28	129.58	--------	--------	1
Freeman	“ 20	“ 10	119.21	20.73	139.94	130.87	183.75	7
Hicks' 81	“ 20	“ 1	77.75	31.1	108.85	124.41	186.3	6
Honeoye Rose (Dep't)	“ 18	“ 2	101.07	25.91	126.98	107.54	--------	2
Irish Cobbler	“ 5	Aug. 25	196.96	41.46	238.42	223.67	--------	2
June Eating	“ 20	Sept. 12	129.58	20.73	150.31	126.98	189.61	8
Kansas	Sept. 1	“ 14	134.76	25.91	160.67	--------	--------	1
King of the Earlies	Aug. 1	Aug. 20	67.38	10.36	77.74	82.97	123.48	3
Michigan	“ 20	Sept. 1	108.85	31.1	139.95	184.41	--------	2
Norther	“ 25	“ 8	124.4	38.87	163.27	178.02	--------	2
Peachblow	“ 20	“ 10	142.54	20.73	163.27	151.6	212.33	3
Pinkeye (Dep't)	“ 22	“ 4	132.17	20.73	152.90	155.49	--------	2
Pinkeye (Read)	“ 27	“ 8	67.38	31.1	98.48	--------	--------	1
Pride	“ 18	“ 6	82.93	38.87	121.80	149.01	--------	2
Quick Crop	“ 22	“ 5	62.2	31.1	93.3	126.48	--------	2
Read's 86	“ 24	“ 5	57.1	31.1	88.11	114.02	129.35	3
Six Weeks	“ 16	“ 1	137.35	20.73	158.08	--------	--------	1
Snowball	“ 28	“ 10	103.66	23.32	126.98	--------	--------	1
Thoroughbred	“ 10	“ 6	67.38	31.1	98.48	115.33	--------	2
Trumbull	“ 18	“ 4	49.24	36.28	85.52	--------	--------	1
Vaughan	“ 14	Aug. 30	106.25	33.69	108.85	103.16	135.05	5
White Lily	“ 16	Sept. 10	93.3	18.14	111.44	104.96	138.3	3
White Ohio	“ 1	Aug. 15	57.01	23.32	80.33	--------	--------	1
Woodbury	Sept. 1	Sept. 16	93.3	51.83	145.13	168.45	--------	2
Woodhull	Aug. 20	“ 8	209.92	31.1	241.02	--------	--------	1
241-3	“ 1	Aug. 20	57.01	15.55	72:56	126.98	--------	2

Plot Planted June 4.

Variety.	Date of maturity.		Yield per acre, bushels.			Average yield for 1896, 1897.	General average.	No. of years averaged.
	Edible.	Market.	Large.	Small.	Total.			
Abundance	Sept. 5	Sept. 16	129.58	31.1	160.68	222.88	--------	2
Accidental	“ 4	“ 16	176.22	25.9	202.72	--------	--------	1
Adirondac	“ 12	“ 17	165.86	20.73	186.59	176.21	--------	2
Alexander Prolific	“ 10	“ 17	72.56	5.18	77.74	207.31	195.3	4
American Beauty	“ 10	“ 17	67.38	10.36	77.74	186.58	--------	2
American Wonder	“ 6	“ 14	77.75	25.91	103.66	69.96	184.48	6
Andes	Aug. 20	“ 1	59.6	15.55	75.15	--------	--------	1
Arizona	Sept. 15	“ 17	67.38	41.46	108.84	--------	--------	1
Battle's Best	“ 10	“ 17	134.76	15.55	150.31	--------	--------	1
Beauty of Beauties	“ 12	“ 17	155.5	10.36	165.86	--------	--------	1
Blush	“ 10	“ 17	93.3	36.28	129.58	--------	--------	1
Breck's Chance	“ 6	“ 15	57.01	15.55	72.56	111.43	114.04	3
Bristol Beauty	“ 18	“ 17	67.38	23.32	90.7	--------	--------	1
Burr No. 1	“ 12	“ 17	98.48	25.91	124.39	--------	--------	1
Carman No. 1	“ 10	“ 17	165.86	23.32	189.18	163.36	188.8	4
Carman No. 3	“ 10	“ 17	147.72	20.73	168.45	247.49	258.41	3
Cayuga	“ 8	“ 16	106.25	28.5	134.76	300.41	207.7	6
Champion of the World	“ 3	“ 12	62.2	18.14	80.34	265.64	--------	2
Clarendon Beauty	“ 8	“ 16	67.38	10.36	77.74	--------	--------	1

Plot Planted June 4.—Concluded.

Variety.	Date of maturity.		Yield per acre, bushels.			Average yield for 1896, 1897.	General average.	No. of years averaged.
	Edible.	Market.	Large.	Small.	Total.			
Columbus	Sept. 10	Sept. 17	124.4	33.69	158.09	--------	--------	1
Endurance	" 12	" 17	57.01	12.95	69.96	--------	--------	1
Enormous	" 12	" 17	165.86	2.59	168.45	353.75	--------	2
Fillbasket	" 6	" 14	82.93	5.18	88.11	165.86	184.28	6
Flagle	" 4	" 12	67.38	15.55	82.93	176.23	--------	2
Fottler's Peachblow	" 12	" 17	88.11	25.91	114.03	236.97	--------	2
General Purpose	" 8	" 14	103.66	18.14	121.8	221.58	--------	2
Good Times	" 8	" 15	134.76	41.46	176.22	--------	--------	1
Harrington Peer	" 1	" 16	259.16	41.46	300.62	--------	--------	1
Harvest Queen	" 4	" 10	77.75	38.87	116.62	229.36	--------	2
Hicks 22	" 8	" 14	88.11	7.77	95.88	281.18	223.88	6
Hicks 101	" 10	" 17	145.13	23.32	168.45	272.11	243.7	6
Honeoye Rose	" 6	" 14	98.48	15.55	114.03	101.07	--------	2
Irish Mignon	" 10	" 17	77.75	10.36	88.11	--------	--------	1
Joseph	" 6	" 14	57.01	41.46	98.47	--------	--------	1
King of the Roses	" 4	" 14	72.56	15.55	88.11	124.49	--------	2
Klondyke	" 8	" 14	165.86	46.65	212.51	--------	--------	1
Leonard	" 6	" 14	51.83	51.83	103.66	--------	--------	1
Lightning Express	" 1	" 10	88.11	25.91	114.02	141.23	179.74	4
Lincoln	" 6	" 15	114.02	46.65	160.67	--------	--------	1
Livingston Banner	" 8	" 15	121.8	23.32	145.12	286.37	--------	2
Long Keeper	" 15	" 17	134.76	25.91	160.67	--------	--------	1
Maggie Murphy (Department)	" 12	" 17	103.66	10.36	114.02	261.74	--------	2
" " (Brown)	" 12	" 17	155.5	10.36	165.86	--------	--------	1
Michigan Beauty	" 8	" 15	25.91	18.14	44.05	81.64	--------	2
Mill's Banner	" 8	" 15	207.33	25.91	233.24	--------	--------	1
" Prize (Butcher)	" 12	" 17	137.35	15.55	152.9	--------	--------	1
Milwaukee	" 6	" 14	103.66	36.28	139.94	124.39	168.86	4
Napoleon	" 12	" 17	67.38	28.5	95.89	263.05	--------	2
O. K. Mammoth	" 6	" 14	67.38	15.55	82.93	199.55	195.76	7
On Top	" 8	" 14	77.75	25.91	103.66	248.40	174.21	6
Onward	" 4	" 12	72.56	23.32	95.88	--------	--------	1
Orphan	" 1	" 10	108.85	15.55	124.4	133.46	203.97	3
Paddleford	" 10	" 17	103.66	44.05	147.71	--------	--------	1
Peachblow	" 14	" 17	103.66	25.91	129.57	282.48	--------	2
Perfection	" 2	" 10	119.21	31.1	150.31	--------	--------	1
Planet Jr.	" 10	" 17	145.13	20.73	165.86	--------	--------	1
Pride of Seneca	" 6	" 14	103.66	31.1	134.76	--------	--------	1
Queen of Paris	" 6	" 14	51.83	15.55	67.38	218.99	220.09	7
Queen of the Valley	" 8	" 16	75.15	12.95	88.1	--------	--------	1
Road's 99	" 10	" 17	114.03	20.73	134.76	--------	--------	1
Rose No. 9	" 4	" 12	57.01	25.91	82.92	132.16	--------	2
Rose of Erin	" 6	" 12	93.3	28.5	121.8	--------	--------	1
Rose Standish	" 4	" 12	98.48	31.1	129.58	152.9	--------	2
Rural New Yorker No. 2	" 8	" 14	129.58	31.1	160.68	321.36	191.74	8
Rutland Rose	" 6	" 14	98.48	15.55	114.03	256.57	--------	2
Seedling No. 2 (Teeter)	" 8	" 17	57.01	15.55	72.56	--------	--------	1
Sir Walter Raleigh	" 8	" 14	134.76	18.14	152.9	--------	--------	1
Snowflake Jr.	" 1	" 10	114.03	20.73	134.76	145.12	--------	2
Suffolk Beauty	" 4	" 14	114.03	28.5	142.53	--------	--------	1
Table King	" 2	" 10	36.28	20.73	57.01	108.84	--------	2
Uncle Sam	" 1	" 9	150.31	25.91	176.22	152.89	--------	2
Unknown	" 10	" 17	72.56	15.55	88.11	95.85	--------	2
Vanguard	" 2	" 12	77.75	10.36	88.11	243.61	221.43	4
Victor Rose	" 10	" 17	64.74	10.36	75.1	143.8	177.02	4
Vigorosa	" 1	" 10	129.58	36.28	165.86	144.12	--------	2
White Gem	" 2	" 10	57.01	15.55	72.56	196.96	227.97	3
" Peachblow	" 14	" 17	93.3	25.91	119.21	--------	--------	1

The early plot was marked May 11, with furrows forty-two inches apart, and each variety was given a forty-foot space in the row; two pounds of seed of each variety were cut into twenty-five pieces, which were dropped by hand about eighteen inches apart, and covered to the depth of four inches. After planting, the ground was rolled, and as soon as the small weeds began to start, Breed's weeder was used at intervals of three to four days, thus keeping the surface loose and aiding in preventing evaporation as well as keeping the weeds down. This method of cultivation was kept up until the plants reached a height of from six to seven inches, after which the Planet Jr. cultivator was used weekly, or after each rain until the vines covered the ground. At all times shallow, level cultivation was given

The late varieties were planted June 4, and cultivated in the same manner. Among the potatoes received from the different seedsmen were several varieties, the season of which was not known, and for comparison the seed was divided equally between the two plantings.

The tables show the results obtained.

The new varieties grown in the test this year were obtained from the following parties:

E. Tully, Penza, Ohio.—*Trumbull;* H. C. Marsh, Muncie, Ind.—*Andes;* Peter Henderson & Co., 35–37 Cortland St., N. Y.—*Uncle Sam*, *Bovee*, and *Sir Walter Raleigh;* D. M. Teeter, Bellaire, Ohio.—*Seedling No. 2;* F. Barteldes & Co., Lawrence, Kan.—*Kansas;* S. F. Leonard, Chicago, Ill.—*Leonard;* J. M. Thorburn & Co., N. Y.—*White Peachblow;* Wm. Henry Maule, Philadelphia, Pa.—*Beauty of Beauties*; Jas. Vick's Sons, Rochester, N. Y.—*White Ohio* and *Vick's Perfection;* L. L. Olds, Clinton, Wis.—*Joseph;* F. B. Mills, Rose Hill, N. Y.—*Mills' Banner*, *Irish Mignon*, and *Long Keeper;* Frank Ford & Sons, Ravenna, Ohio.—*Lincoln* and *Columbus;* Geo. W. P. Jerrard Co., Caribou, Me.—*Stray Beauty*; E. J. Smith, Paddleford, N. Y.—*Smith's Six Weeks*, *Burrs No. 1*, *Paddleford;* John A. Salzer, La Crosse, Wis.—*Good Times;* C. C. Brawley, New Madison, Ohio.—*Endurance*, *Algoma*, *Arizona*, *Queen of the Valley* and *Onward;* T. H. Glover, Mancelona, Mich.—*Harrington's Peer;* B. W. Steere, Carthage, Ind.—*Accidental;* E. W. Butcher, Albion, Mich.—*Mills' Prize;* Galusha D. Oathout, Wolcott, N. Y.—*Clarendon Beauty;* R. H. Brown & Co., Victor, N. Y.—*Blush*, *Honeoye Rose*, *Planet Jr.*, *Maggie Murphy*, *Rose of Erin*, *Pride of Seneca*, *Woodhull;* Wm. Myers, Mears, Mich.—*Klondyke;* Dison J. Porter, Three Rivers, Mich.—*Battles' Best;* F. W. Read, Grand Rapids, Wis.—*Early Snowball*, *Early Pinkeye*, *Bristol Beauty*, *Suffolk Beauty*, *Read's 99.*

SUMMARY.

The new varieties that promise to become standard sorts, are found in the following list :

Early Varieties.

Among the varieties maturing first, *Irish Cobbler* (238.42 bu.) takes the lead and increases its yield of last year. *Six Weeks* (158.08 bu.), *Algoma* (98.30 bu.) and *White Ohio* (80.33 bu.) are very promising extra early sorts.

Medium.

The medium sorts gave the largest yields this year. *Harrington's Peer* planted June 4, was mature September 1, and yielded (300.62 bu.) per acre, *Woodhull* (241.02 bu.), *Accidental* (202.51 bu.), *Uncle Sam* (176.22 bu.) and *Klondyke* (212 12 bu.) gave nearly as good results and are excellent in quality.

LATE VARIETIES.

Frost killed the vines September 17, and though it did not affect the edible qualities of the tubers, it checked the growth of the late sorts and is a partial cause of the small yield. *Mills' Banner* (233.24 bu.), *Good Times* (176.22 bu.), *Planet Jr.* (165.86 bu.) and *Sir Walter Raleigh* (152.9 bu.) were among the large yielders among the new varieties, but others of less recent introduction, including *Carman No. 1.* (189.19 bu.), *Carman No. 3* (168.45 bu.), *Enormous* (168.45 bu.), *Rural N. Y. No. 2* (160.68 bu.), *Peachblow* (129.57 bu.), *Livingston Banner* (145.12 bu.) and *Beauty of Beauties* (165.86 bu.) are productive and good keepers.

NEW VARIETIES.

Accidental.—A medium early variety of excellent quality and quite productive. Tubers, medium to large; shape irregular, oblong; eyes numerous, evenly distributed, long, narrow, slightly sunken, and strong sprout centers; skin smooth, netted in patches, rose tinted; flesh cream white, firm, dry and fine grained. Vine stout, spreading, rather long.

Algoma.—A new variety of the Hebron class originated in Minnesota, that is worthy of further trial; size medium; shape oblong and a little flattened, with broad, open, shallow eyes, located mostly on the seed end; lip well marked but not prominent, skin white, smooth, with slight traces of russet; flesh firm, of good texture, dry; fairly productive. Vines short, spreading, stems green. A variety that possesses superior qualities and promises to be a valuable early home or market sort.

Andes.—Size medium to large; shape ovate to oblong; eyes numerous, narrow, pinkish, rather shallow, evenly distributed over the entire surface; skin delicate light pink with russet appearance; flesh firm, white, fine grained, very dry. Vines upright, rather short. It was grown under unfavorable conditions and gave only a small yield. Said to be a productive early sort.

Arizona.—One of the Rose type with strong, vigorous vines. Tubers small to medium, oblong, irregularly flattened; eyes numerous, of medium depth; broad, with well marked lip, having a slight protuberance from the middle of the curve; skin netted, thin, white; flesh white, firm, of fine texture and dry. Vines spreading, rather long. Season medium; yield rather small. Will be given further trial.

Battles' Best.—The tubers are medium to large; shape round, slightly flattened; eyes numerous, broad, shallow, cream-tinted, well scattered over the surface; skin cream-tinted, russet and thin; flesh coarse, irregularly veined, whitish, firm but a little watery. It would probably have been more productive had it matured before the frost killed the vines. Vines tall, slender, nearly upright.

Beauty of Beauties.—A new variety with promising characteristics. Season medium to late; quite productive. Size medium; shape ovate to oblong, flattened; eyes broad, shallow, white; lip not prominent though well marked; skin pale pink, slightly netted; flesh white, fine grained, rather soft and watery. Vines quite tall, strong, upright. Owing to its handsome appearance it will be included in the list for further trial.

Blush.—A medium late variety with strong, rank growing vines. Size, medium to large, round to oblong; eyes small and shallow, well distributed; sprout center strong and pink in color; skin pink, netted; flesh white, dry, firm, fine texture. Stems dark green, spreading, medium length. Productiveness above the average. This variety has the markings of a fine potato and will be carefully watched in the future.

Bristol Beauty.—A variety introduced from Wisconsin. Tubers rather small, oblong, regularly flattened; eyes long, shallow with a well marked sharp lip, pink in color; skin pinkish white, slightly russeted; flesh veined through the center, firm, fine texture, dry. Season medium, somewhat lacking in productiveness. Stems rather long, spreading.

Burr No. 1.—This variety possesses characteristics, that in many localities will make it a desirable sort. It is of good size, fine quality and productive, as well as a good keeper. Stems rather short, spreading.

Clarendon Beauty.—A new variety originated in Clarendon, Orleans County, N. Y. Tubers medium size, oval, flattened; eyes long, broad, open, shallow; color pinkish white with a strong sprout center; skin rose-tinted, finely netted; flesh white, firm, fine grained and dry. Stem tall, nearly erect. Season medium late; lacking in productiveness. Seems to be worthy of further trial as it is quite attractive and possesses some superior qualities.

Columbus.—A variety with strong rank vines, not seriously affected by dry weather. Tubers medium to large, ovate to oblong in shape; eyes broad, near the surface, slightly pink-tinted; lip well marked; skin pinkish white, thin, coarsely netted; flesh cream white, firm, fine grained, dry. Season late and quite productive. This variety is largely advertised and will be given further trial. Rather tall, medium, spreading.

Endurance.—A late variety that in many localities would not mature. Tubers of medium size, round, oblong; eyes numerous, near the surface; skin slightly rusty, cream white, thin; flesh very white, fine grained, firm, but a little watery. Rather tall, upright. It is a well formed potato and if sufficiently productive will be desirable as a late keeping variety.

Good Times.—Closely resembles *Champion of the World.* The potatoes are medium to large in size; shape oval, slightly flattened; eyes broad, very shallow, slightly lipped and of a delicate pink color; skin finely netted, very thin and pinkish white; flesh firm, of good texture, white and dry. Rather tall, upright, somewhat spreading. A medium late sort that appears to be quite productive. This promises to be a valuable, general purpose potato, as it possesses many points of merit.

Harrington Peer.—A variety that exceeded all others in productiveness. Tubers medium to large, oblong, flattened; eyes numerous, broad and shallow, with a sharp but not prominent lip; skin light pink or rose color, smooth and slightly netted; flesh white, fine grained, firm and dry. It is said to be a seedling of Early Rose, and will take its place on the market, being equal to it in appearance, quality, etc., and promises to be a better yielder. Vines strong, quite tall and upright.

Honeoye Rose.—A fairly productive medium early variety, which possesses points that will make it one of the leaders in the Rose class. The potatoes are of good size, desirable in form and high quality. Stems of medium height, upright, green.

Irish Mignon.—Tubers small to medium, round; eyes slightly sunken, narrow and small, pink tinted; skin cream color, thickly covered with russet; flesh creamy white, firm and dry. Vines of medium height, slender, spreading. Season very late; fairly productive. For growers who prefer a round potato this seems to be a promising late sort.

Joseph.—Originated by the introducer of the old variety *Polaris*. It equals it in quality and excels it in yield. The vines are strong growers; tubers medium to large, slightly flattened; eyes prominent, deeply indented and with a strong lip; skin cream white with slight russet patches; flesh white, firm, of fine texture. Rather tall, spreading. Season medium; fairly productive. Admirers of *Polaris* should add this sort to their list.

Kansas.—A variety strongly resembling Ohio, but it is more productive and matures about two weeks later. Tubers large, irregular, round oblong in shape; eyes numerous, evenly distributed, rather deep and with a purple tint; skin fine russet, rather thick; flesh firm, creamy white, a little coarse, rather watery. Stems green, spreading, medium height. Season medium early and quite productive.

Klondyke.—A white potato worthy of trial. Size medium to large; oblong flattened; eyes shallow, narrow and scattering; skin cream white, slightly russet, finely netted; flesh very white, firm, fine and dry. Season medium. It was one of the largest yielders and this with its other valuable characteristics should make it one of the leading varieties.

Leonard.—Quite productive and a little earlier then Rural New Yorker No. 2, which it resembles in appearance, except that it is less flattened. Tubers of medium size, oblong, slightly flattened; eyes shallow, with a rather indistinct lip; skin pinkish white, finely netted; flesh white, firm, of medium grain, dry. Vines spreading, medium height. Its only superiority over the Rural is that it is less apt to be hollow. It is medium early and appears lacking in productiveness.

Lincoln.— The original seed of this potato was brought from Norway, where it was considered one of the best varieties. It seems to have lost none of its good qualities. The tubers are of medium size, oblong, flattened, with small, rather deeply sunken eyes; lip sharp and well marked; skin white with faint pink patches scattered irregularly over the surface; flesh white, of fine texture, firm but a little watery, which would probably disappear later in the season. Season medium, quite productive. Stems tall, nearly upright.

Long Keeper.—Vines very strong, rank growers; tubers small to medium, irregular in shape, the majority being round to oval and flattened; eyes numerous, very red, situated mostly at the seed end, broad and rather deep; skin covered with many dots, cream white; flesh white, firm, fine grained. Quite late and productive. Strong, tall, rather spreading. Judging from its firmness it promises to be true to its name as a keeper.

Mills' Banner.—Similar to *Livingston's Banner* and possesses qualities that make it an acquisition to a potato grower's list. Season late and one of the most productive varieties grown. Rather long, spreading vines.

Mills' Prize.—Shows no superiority over *Prize* grown here for the past two years. Quite late and fairly productive. The tubers are of good size, of desirable form and excellent in quality.

Onward.--A new variety which resembles *Great Divide* in color, shape and time of ripening. The tubers are of medium size, oval to oblong in shape; eyes small, shallow, cream white; lip distinct; skin smooth with finely netted spots, a delicate white cream color; flesh firm, fine grained, white, rather watery. Stems of medium height, spreading. Owing to its smoothness and other desirable qualities, it is likely to become one of the standard late sorts.

Paddleford.—A new late variety originated at Paddleford, N. Y. Tubers rather small, ovate to oblong in shape, with small eyes; skin pinkish white; flesh dry, brittle, fine grained, firm and white. Stems tall, strong and upright. It seems to have the essentials of a good potato, and is fairly productive.

Perfection.—A medium variety that, owing to its productiveness and fine appearance, together with its superior quality, is bound to be a valuable general purpose sort. Tubers large, oblong, slightly flattened; eyes prominent, but near the surface, slightly pink tinted; skin cream white with traces of pink coloring; flesh very white, of fine texture, dry. Fairly productive. Rather long spreading vines.

Planet, Jr.—One of the largest yielders among the recent introductions. Tubers medium to large, oblong, slightly flattened; eyes numerous, slightly raised and evenly distributed over the surface; skin finely netted, delicately pink tinted; flesh white, fine grained, firm and dry. Very few late varieties promise to be superior to this. Vines medium length, low and spreading.

Pride of Seneca.—A potato with many strong points. Medium to large in size, oblong, flattened; eyes numerous, slightly raised, broad, very strong, slightly pink in the center; skin netted, reddish-pink; flesh very firm, fine grained and dry. Season medium; fairly productive. Stem of medium length and size, spreading.

Queen of the Valley.—A variety so closely resembling *Maggie Murphy* that it is difficult to distinguish them. In fact, *Maggie Murphy*, as grown here, produced tubers that seemed identical with *Queen of the Valley.* Vines tall and strong. Both are valuable sorts, being, as a rule, productive and of fair quality.

Read's Ninety-nine.—An attractive white potato of medium size, oblong, slightly flattened; eyes broad, shallow, very pink; skin cream white, smooth. with slight russet markings; flesh firm, white, fine grained, and dry. It seems to be productive and of excellent quality.

Rose of Erin.—Largely advertised as a desirable general purpose potato. Tubers medium to large, oblong to ovate, flattened; eyes numerous, evenly distributed, narrow and deeply sunken, partly closed with a prominent lip; skin finely netted, pink, very thin; flesh white, rather coarse, but firm and dry. Vines of medium length, spreading. Season medium; rather low in productiveness.

Seedling No. 2. (Teeter.)—A new variety of handsome appearance but lacking in productiveness. Of large size, oblong, flattened in form; eyes shallow, scattering, broad and very strong; skin pure white, finely netted; flesh white, firm texture and very dry. Vines of medium length, low and spreading.

Sir Walter Raleigh.—A seedling of *Rural New Yorker*, which promises to excel its parent, as it seems to be firmer, and less liable to become hollow. Rather tall and upright. The size and shape are very desirable, its quality excellent, and it will take its place on the market as a medium late white potato.

Six Weeks. (Smith.)—A medium early sort of good quality, somewhat resembling Hebron. It is productive on trial as a garden or field variety. Vines of medium height, spreading, green.

Snowball.—A medium early variety, which possesses some very desirable qualities, but it is rather small and appears to be slightly watery.

Stems low, green and spreading. The tubers are very attractive and it will be grown again next year.

Suffolk Beauty.—One of the Rose class. Medium in size, of irregular, oblong shape with numerous deep pink eyes; skin pink, finely netted and filled with small, light dots; flesh pure white with slight traces of pink veins running through it. Season medium; fairly productive. Vines of medium height, spreading.

Trumbull.—A medium early sort that is of fine quality though hardly up to the standard in productiveness. The tubers are of medium size, oblong, flattened, with shallow, open eyes; skin clear white, a little netted, and the surface speckled with numerous small white dots. The texture and flavor are of high quality. Vines of medium height, spreading, green.

Uncle Sam.—One of the white varieties introduced in 1896. It is of excellent quality and of handsome appearance; although not satisfactory in productiveness last year, it has made a good showing the present season. Vines strong, vigorous, spreading.

Woodhull.—One of the varieties that was planted at different dates proved itself to be a very valuable medium early sort. Tubers white, of fine shape, excellent quality and quite productive. Rather tall, green, spreading stems.

White Peach Blow.—A seedling of the *Excelsior*, closely resembling the old *Peach Blow*, but being earlier in ripening, it is even more desirable. The skin and flesh are of floury whiteness; eyes strong, broad, of medium depth. It is a very strong, upright, rank grower with large pink blossoms and may take the place once held by *Peach Blow.*

L. R. TAFT.
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AGRICULTURAL COLLEGE, MICH., January 1, 1898.

SOME EXPERIMENTS IN CORN RAISING.

CLINTON D. SMITH, DIRECTOR AND AGRICULTURIST.

Bulletin 154.—Farm Department.

SUMMARY.

The yield of corn is dependent in no small degree on the quality of the seed, which should be selected before the corn is cut, having regard to the size and character of the stalk as well as to the ripeness and type of the ear. When the season is especially favorable for thoroughly maturing the ears, enough seed to last at least two years should be gathered, completely dried out before frost, and stored in a warm, dry place. A difference of 11% in the yield of dry matter on two adjacent acres was noted in favor of the crop grown from well ripened seed over the yield from seed grown in a wet, cold season.

For the silo, the corn may well be planted in drills about three and one-half feet apart and with kernels from two to six inches apart in the row. In a very wet season a heavier crop may be harvested from plots drilled with a grain drill, every tube sowing, but the greater yield of protein and other valuable nutrients was found in these experiments to be in the crop planted with less seed per acre.

Frequent cultivation prevents the evaporation of moisture from the soil and secures its retention for the use of the corn plant.

When the corn is ripe or nearly so, the dry matter which the crop contains is found, about one-half in the ears, less than a third in the stalks and one-fifth in the leaves. About one-half of the total protein content of the plant, 58% of the albuminoid nitrogen, 54.7% of the N. free extract and but 17.4 per cent of the ash elements are found in the ears. In the case of sweet corn 52% of the total dry matter, 63.74% of the protein and 60.56% of the N. free extract were found in the ears. Of sorghum the larger share of the total weight in dry matter is found in the stalks; but, on the other hand, 45.56% of the protein is in the leaves, a little more than a third in the tops and less than a fifth in the stalks. These experiments go to show that in harvesting either of these forage crops attention should be given to the preservation of the leaves and stalks, since they contain so large a proportion of the nutritive ingredients.

In 1897 it was found that when the corn was nearly ripe less than half of the dry matter was in the ears, the other half being about equally divided between the stalks and the leaves.

One way of preserving the fodder in good shape for feeding is to put both ears and fodder into the silo. As to the stage of ripeness at which the crop should be cut, the results of the experiments carried on in 1896 and 1897 go to show that the maximum yield of dry matter and nutrients is obtained by allowing the crop to mature until the ears are well glazed. Between the time when the kernels begin to glaze and full ripeness there is a gain of over one-eighth in dry matter, one-sixth in starch, sugar and other carbohydrates and one-fifth in fat. The study of the losses in the silo go to show that there may be a danger of allowing the corn to stand too long, especially in hot and dry weather, making the silage too dry to secure the proper fermentation. No regular and consistent variation in extent of loss was noted which could be related to the age of the corn when cut.

SELECTION OF THE SEED.

It is the usual practice at the Station to carefully select the seed corn in the autumn, as far as possible, before the crop is cut. The reason for selecting at this time is that the corn is used largely for the silo and it is therefore important to have well grown stalks as well as large and fully ripened ears. While the plants are standing, it is not difficult, when passing along between two rows, to pick out the large stalks, bearing ears of the typical shape, of early maturity and filled out at both butt and tip. At the time of husking and thereafter the ear alone is regarded, which is not sufficient for our purpose.

The seed corn is dried out rapidly before frost and kept in a warm, dry room during the winter. The value of the seed depends as well upon this thorough drying before freezing as upon the first careful selection. At the time of selection, part of the husks are left on some of the ears any by tying or braiding the husks of separate ears together a string of them is made which is fastened to the rafters to escape the depredations of mice and rats. From most of the seed corn the husks are entirely removed and the ears are placed upon slatted platforms, suspended by wire from the ceiling of the seed room and there are thoroughly dried. By treating the seed corn in this way, a high per cent of germination is secured as well as strong vitality in the young plants.

A third important factor enters into the value of the seed, viz., the character of the season. If the season has been such as to thoroughly mature the crop until the kernels are well filled out, packed tightly together on the cob and are fully ripe, the crop grown from such seed will be larger than if the seed is defective in any of these particulars.

To illustrate this point, a test was made in Field 8, of the College farm in 1897. Two plots 94 rods long and wide enough to contain, each, four rows, 42 inches apart, were planted, the one with seed corn grown in 1895 and the other with seed from the crop of 1896, the previous year. The treatment of the seed had been identical after harvesting but, in 1895, the crop was fully ripened while, in 1896, the weather was wet and cold just prior to corn harvest and although the seed was selected with care it was impossible to find as fully matured ears as were found in 1895. The two plots were planted alike and treated the same during the season. The crop was harvested for the silo the same day.

From the time when the corn was an inch high, there was a conspicuous difference in the growth of the two adjacent plots. The one planted with the seed of 1895 grew more rapidly and more vigorously; the seed germinated more quickly and the shoots were more vigorous from the start. The results at harvest were as follows:

	Gross yield per acre. Lbs.	Dry matter per acre. Lbs.
Plot 4, seed of 1896	17,210	6,970
Plot 5, seed of 1895	19,134	7,749

Here was a difference of over 11 ¢ in favor of the crop grown from the seed of 1895, although that seed was a year older.

An opportunity was afforded to study this matter farther, incidentally, in another part of the same field, although the corn was not planted for that purpose. Three adjacent plots, 94 rods long, were planted in hills three feet and nine inches apart each way. Plot 7, was planted with a hand planter, Plot 8, with hoes, and Plot 9, with a check rower. The seed of 1896 was used on Plots 7 and 8, and, the supply being exhausted, the seed of 1895 was substituted in Plot 9. The yields were as follows:

	Gross yield. Lbs. per acre
Plot 7, seed of 1896, planted with hoe	10,670
Plot 8, seed of 1896, planted with hand planter	13,093
Plot 9, seed of 1895, planted with check rower	15,945

No definite conclusion could be predicated from these results of the yields of these three plots because Plot 9 was planted in a different way from Plots 7 and 8. How much of the difference in yield was due to the difference in seed and how much to the difference in the method of planting cannot be even estimated; but it seems safe to ascribe at least part of the increased yield to the use of the better seed. The results in the first test point very clearly in this direction. It is the universal experience of thrifty farmers that it pays to carefully dry seed corn and protect from severe freezing. It seems equally certain that the ripeness of the corn when harvested is as important as subsequent treatment.

THICKNESS OF PLANTING.

The next question which arises in growing corn is, how thickly shall the seed be planted to secure the greatest yield per acre. Experiments to aid in answering this question were performed both in 1896 and 1897.

In 1896, the season was unusually moist, with a rainfall well distributed through the summer months preventing a drouth or even a long dry spell. The newly planted corn was materially injured by wire worms and grubs, interfering with the accuracy of the experiment. The work was carried on in Field 6, on a level and fairly homogeneous area. Five adjacent plots approximately forty rods long were used. Plots 1 and 2 contained a quarter acre each, Plots 3, 4, and 5, one-half acre each. On Plot 1 the corn was drilled with an ordinary grain drill, every tube sowing. The rows were therefore but seven inches apart.

Leaving the drill rigged as for Plot 1, except that each alternate tube was stopped up, Plot 2 was planted in rows 14 inches apart, very thick in the row, the average distance between kernels being about three inches.

On Plot 3 the drills were two feet and four inches apart the kernels being about three inches apart in the row.

On Plot 4 the rows were three feet and nine inches apart and the corn was in hills one foot and ten inches apart in the row, four kernels to a hill.

On Plot 5, the corn was planted in hills three feet and one-half apart each way, four kernels in a hill. This plot suffered much more from cut worms than did the others in the series. The corn was planted May 8 and 9, and was cultivated in the early part of the season with a Breed's weeder as often as the frequent showers would allow. Later, single and two-horse cultivators were used, somewhat infrequently, on account of the wet weather. Plots 1 and 2 could not be cultivated, but the weeds were pulled from them on the first of August. The corn grew so rapidly that these weeds were choked and it did not require much labor to remove them.

The corn was put in the silo September first, the yields of the different plots being weighed separately and samples taken for analysis. The first table shows the chemical composition of the *dry matter* of the crop as harvested from the various plots.

Composition of the dry matter of the crop from different plots in 1896.

	Dry matter. Per cent.	Total N. Per cent	Alb. N. Per cent	Fat. Per cent.	Ash. Per cent	Crude fiber. Per cent.	Protein. Per cent	N. free extract. Per cent.
Plot 1	30.75	.51	.38	1.75	4.58	26.13	3.19	64.35
Plot 2	32.24	.55	.38	2.02	4.32	23.63	3.43	66.60
Plot 3	34.31	1.19	1.04	3.59	3.97	18.12	7.44	66.88
Plot 4	30.06	1.07	1.00	3.19	4.23	20.79	6.69	65.10
Plot 5	29.18	1.11	.95	3.55	4.24	19.25	6.93	65.03
Silage corn	29.16	1.36	1.31	3.61	3.68	17.96	8.50	66.25
Sorghum	19.91	.89	.49	5.81	5.17	28.17	5.56	55.29

For sake of comparison the composition of silage corn and of sorghum grown on an adjacent field and planted in rows three feet apart with hills eighteen inches apart in the row, is given.

The table shows that the corn thickly sown on Plot 1 contains but little more water than where the stalks were larger and farther apart. It is the popular belief that where corn is planted so thick that the stalks are thereby made small and weak the crop is "watery." The results of this experiment do not confirm this belief.

One of the most valuable constituents of corn fodder and grain is the protein. The composition of the corn grown under the different conditions herein reported shows that, where the corn is drilled as in Plot 1, or drilled in rows 14 inches apart as in Plot 2, the per cent of protein is but little more than half as much as where the sun and wind are allowed to circulate freely about the separated plants as in Plots 4 and 5. The composition of the corn in Plot 3, is evidently abnormal, due to the work of cut worms and other insect enemies which had thinned the corn, rendering the correct interpretation of the results exceedingly difficult. The experiment notwithstanding this blemish, indicates very clearly that the per cent of protein in the corn crop as a whole, including stalks and ears, increases as the amount of seed decreases, up to the point where each particular corn plant receives its full amount of sun and air.

The amount of starch, sugar and other soluble carbohydrates included under the general term of N. free extract does not seem to be influenced by the thickness of planting. The same is true of the ash. Of the crude fiber there is a greater proportion present in the yields of the thickly sown plots.

The next table gives the yields of each plot not only of green fodder but of dry matter, protein, N. free extract, crude fiber, and fat as well.

Yields per acre of the thickly sown and thinly planted plots in 1896.

	Green fodder. Lbs.	Dry matter. Lbs.	Protein. Lbs.	N. free extract. Lbs.	Crude fiber. Lbs.	Fat. Lbs.
Plot 1	30,608	9,411.96	300.24	6,056.59	2,459.35	164.71
Plot 2	17,008	5,483.38	188.08	3,651.93	1,295.72	110.76
Plot 3	21,860	7,500.17	558.01	5,016.11	1,359.03	269.26
Plot 4	19,344	5,814.81	389.01	3,785.44	1,208.90	185.49
Plot 5	16,416	4,790.19	331.96	3,115.06	922.11	170.05
Silage corn	29,684	8,655.85	735.74	5,734.50	1,554.59	312.48
Sorghum	38,676	7,700.39	429.14	4,237.45	2,169.20	447.39

Possibly on account of the wet season, Plot 1 drilled in rows only seven inches apart gave the greatest yield of green forage and dry matter. The plot next to it with rows 14 inches apart returned but little more than half as much while Plot 3, with rows 28 inches apart, returned two-thirds as much green forage and nearly eighty per cent as much dry matter. In studying the table it must be borne in mind that the field was infested with both wire worms and cut worms whose depredations have influenced the results.

Turning now from the dry matter to that most valuable constituent, protein, the experiment shows us that although the yields of Plots 3, 4 and 5, were much less than that of Plot 1, both in green fodder and dry matter they exceeded Plot 1 in the amount of protein.

The yield per acre of the N. free extract is also worthy of notice. Here the thickly-sown plot returned the largest amount. The same is true of the crude fiber.

Before discussing farther the experiments of 1896, recognizing the danger of drawing conclusions from the results of a single trial, it may be well to review the results of the experiment of 1897. This test was made on the south side of Field 8 of the College farm. The plots were 94 rods long. Plot 1, was 14 feet wide, and was planted as in 1896 with the same grain drill, every tube sowing. Plot 2, was also 14 feet wide and as in 1896 the rows were 14 inches apart, being sown by each alternate tube of the grain drill. The kernels were on the average three inches apart in the row. In Plot 3 the rows were 28 inches apart and in Plot 4, 42 inches The corn was harvested September 15th. The next table shows the composition of the dry matter of the yields of each plot.

Composition of the dry matter of the crop from different plots in 1897.

	Dry matter. Per cent.	Total N. Per cent.	Alb. N. Per cent.	Fat. Per cent.	Ash. Per cent	Crude fiber. Per cent.	Protien. per cent.	N. free extract. Per cent.
Plot 1	35.21	.64	.57	1.63	4.92	22.68	4.00	66.77
Plot 2	37.[illegible]	.85		2.10	5.52	21.53	5.31	65.54
Plot 3	39.10							
Plot 4	40.50	1.21	1.10	3.16	3.61	15.58	7.56	70.09
Silage corn	30.62	1.26	1.11	2.56	4.70	19.00	7.88	65.86

In 1897 there was no prolonged drouth although little rain fell during the summer months. The supply of moisture was too limited to permit a full growth of the corn in Plot 1 where the plants were crowded. Differing in this respect from 1896, the thickly-sown corn contained nearly 65 per cent of water while that of Plot 4, contained but 60. The variation in richness in protein is conspicuous, but four per cent in the thickly-sown corn as against 7.56 per cent where the rows were 42 inches apart. The variation in the content of crude fiber is shown by the table. The more thickly the corn is sown the greater the per cent of crude fiber. In this instance the N. free extract is more abundant in the corn planted thin than in the thickly-sown plots.

The next table gives the yields of the plots in green crop, dry matter and nutrients.

Yields per acre of thick and thin seeding in 1897.

	Green fodder. Lbs.	Dry matter. Lbs.	Protein. Lbs.	N. free extract. Lbs.	Crude fiber. Lbs.	Fat. Lbs.
Plot 1	16,870	5,940	237.87	3,965.97	1,347.00	96.67
Plot 2	19,724	7,454	394.48	4,871.83	1,600.4	156.01
Plot 3	16,100	6,295				
Plot 4	17,210	6,970	526.80	4,885.23	1,085.78	120.11
Plot 6	20,987	6,426	506.21	4,232.24	1,220.81	164.32

In 1897 the yield of green forage from the thickly-planted plot did not as in 1896 exceed the yields from the plots more thinly planted. In dry matter, too, Plots 2, 3 and 4 exceed Plot 1; the yield of protein in Plot 4 was more than double that of Plot 1; in fact it is in crude fiber alone, that least valuable nutrient, that Plot 1 excels the other plots of the series.

A study of the above tables teaches, among others, the following practical lessons, although the work will need to be repeated many times before definite and positive conclusions can be drawn:

1. As to the dry matter, the first lesson is that you cannot measure the value of an acre of forage crops grown under different conditions by the gross weight alone. Unless you know how much water they each contain, you cannot compare the relative values of the crops from two adjacent plots. Thus while in 1896 the sorghum yielded 38,676 pounds of green fodder as against 29,684 for the silage corn, the latter gave 8,655.85 pounds of dry matter or over 955 lbs. more to the acre than did the sorghum.

2. The protein content of a substance is found by first determining the nitrogen and multiplying that result by 6.25. It is the total nitrogen, no matter whether that nitrogen is in the albuminoid or amide form that is used as the multiplicand in this calculation. The tables show that where the corn was thickly planted as in Plots 1 and 2 of 1896 and Plot 1 of 1897 a very large proportion of the nitrogen is in the amide form. The proportion of amide nitrogen grows less the farther apart the corn plants grow and the more sunlight admitted to them. Experiments have gone far to show that amide nitrogen is not as valuable as albuminoid nitrogen. The protein therefore which contains the larger per cent of amide nitrogen is less valuable than that which contains a less amount of it. The protein from the thickly-planted plots contains a much greater proportion of amide nitrogen than that derived from the plots where less seed was used. While over one-quarter of the protein in Plot 1 of 1896 is calculated from amide nitrogen, in Plots 4 and 5 on the average about ten per cent comes from the amide nitrogen. The statement of the protein content of the different yields of these plots is not sufficient alone to indicate the actual difference in the feeding value of the nitrogenous constituents.

It is interesting to note that not only does the protein grow better in quality as the rows are farther apart in the plot but it increases in quantity as well. Beginning with 3.19 per cent of protein in the dry matter of Plot 1 of 1896, the proportion in the dry matter increases rapidly as the quantity of seed lessens. Where the rows were twice as far apart, in Plot 2, the per cent in the dry matter has increased to 3.43. In Plot 4 where the rows were 42 inches apart the proportion in the dry matter was more than double that in the dry matter of Plot 1. Where the hills were placed three feet and one-half apart in the row the distance between the rows remaining the same the per cent increased from 6.69 to 6.93. The results in 1897 show the same increase in the per cent of protein in the dry matter as we proceed from the thickly to the thinly-planted plots. Where the corn was drilled in, the dry matter contained but 4 % of protein, where the rows were 42 inches apart it contained 7.56 %, almost double.

3. It will be of interest to the practical dairyman as well to note that while the proportion of such soluble matters as are included under the term of nitrogen free extract remains about constant in the different plots, the crude fiber decreases in per cent as we go from the thickly-sown to the thinly-planted plots. This fact is so far contrary to the accepted belief that it is worthy of notice. The results of 1897 confirm those of 1896 in this respect.

One of the early experiments performed to test the relative value of thickly-sown and more thinly-planted corn was made at the Cornell University in 1888. The results are summarized in the following table, in which the yields per acre are given:

Results of Cornell experiments.

Mode of culture.	Dry matter. Lbs.	Protein. Lbs.	Carbohydrates. Lbs.	Fat. Lbs.
Hills, 3x3 ft.	4,431.30	445.80	3,709.90	96.60
Drills, 3 ft. apart	5,291.60	529.20	4,429.60	111.10
Broadcast	3,196.00	229.80	2,668.00	77.00
Broadcast	3,488.00	263.70	3,001.30	57.20

The last plot in the table was harrowed after the corn was up. The season was an unfavorable one but the results show conclusively that the yield of nutrients per acre is much less where the corn was sown broadcast and thick than where it was planted in hills or drills and cultivated. The plots were small, tenth acre, and the variety of corn was a strain of Sibley's Pride of the North. (Cornell Bulletin IV.)

In 1889 an experiment was performed at the Connecticut State Experiment Station to test the influence of the rate or distance of planting on the quantity and quality of the maize crop. The rows were four feet apart. On one series of plots one stalk was allowed to grow for every four feet of row thus allowing 16 square feet to a plant. On the next series one stalk grew for every two feet of row, on the third one stalk to a foot, on the fourth two stalks to a foot, on the fifth four stalks to a foot and on the sixth eight stalks to a foot, the distance between the rows being maintained at four feet. The corn was cut and husked and was not put in the silo. Two varieties of corn were used, one a large dent variety, the other a small flint. In the case of the latter variety the greatest yield per acre of dry matter, protein, N. free extract and fat was where there was one stalk to a foot in the row. The large dent gave the greatest yield of dry matter, protein, N. free extract and fat, where there were two stalks to a foot of row.

"The per cent of ash and albuminoids in the water free crop was greatest where the stand of maize was thinnest and decreased regularly as the stand was thicker, being least where the stand was closest. The difference was quite small in the case of ash but very large in the case of albuminoids (protein).

"Study of the results with the flint variety of maize shows (1) the quantity of ash or mineral matter, of albuminoids, of fiber, of N. free extract and of fat, every valuable ingredient in the crop was largest when the plants stood one to a foot.

"(2) A stand of two to a foot, Plot J, produced very little more of any ingredient than a stand of one to two feet, Plot H. The single exception to this is N. free extract. Plot J produced 23 pounds more of this substance than Plot H.

"Examining the results with the dent variety of maize it appears: (3) The quantity of ash or mineral matter, of albuminoids, of N. free extract, and of fat was largest when the plants stood two to a foot, Plot D, but the largest quantity of fiber was produced by the thickest planting, eight plants to a foot, Plot F.

"(4) A stand of one plant to a foot produced more of every ingredient except fiber than a stand of four to a foot, so the rate which would have given the maximum yield was either two to a foot or between one and two to a foot." (Report of Conn. State Sta. for 1889, page 30.)

A consideration of the results of our own experiments in connection with a study of the work elsewhere would lead to the conclusion that with our ordinary varieties of corn planted for silage in Michigan, a safe distance apart would be three feet and six inches for the rows with kernels three to six inches apart in the row.

CULTIVATION.

The corn ground is plowed to aerate it, to loosen it, and make it easily penetrable by the roots of the growing corn plant. It is harrowed to make the particles fine, to break up clods and to give an even tilth to a considerable depth so that the soil may receive and retain the water that falls upon it. After the corn is planted the object of cultivation is two-fold, to destroy the weeds and by creating a soft fine earth mulch at the surface, prevent the escape of moisture through evaporation. Some experiments, necessarily tentative and preliminary, were made during the season of 1897, to test the effect of cultivation on the conservation of soil moisture.

The work was carried on by Mr. M. W. Fulton in the regular corn field, Field 8. This field had been heavily coated with barn manures during the winter previous, applied to a crimson clover stubble. The ground was plowed early in the spring, thoroughly harrowed and planted to corn May 8, in hills three feet and nine inches apart each way. The corn was harrowed with a Breed's weeder and had been cultivated on two different dates with a two-horse cultivator prior to June 25th, when the three plots were laid off for this test. Each of these plots measured one hundred and twenty-four feet by eleven feet and three inches. The soil was reasonably uniform on the three plots, a sandy loam over a subsoil which inclined to become hard when dry. A mechanical analysis of the soil and subsoil shows the following results:

Mechanical composition of the soil in cultivation experiments in 1897.

	Water. Per cent.	Organic matter. Per cent.	Fine gravel. Per cent.	Coarse sand. Per cent.	Medium sand. Per cent.	Fine sand. Per cent.	Very fine sand. Per cent.	Silt. Per cent	Fine silt and clay. Per cent.
Soil	.38	4.22	2.44	4.64	9.55	25.23	17.74	13.28	21.22
Subsoil	.44	2.58	2.49	4.44	8.10	22.26	18.08	13.21	26.22

The analysis was made by the method recommended by the Division of Soils, of the Department of Agriculture at Washington. The high per cent of sand with the somewhat low per cent of clay and the ample supply of organic matter classes his soil with the loams. It contains more sand and less clay than a typical wheat soil. The subsoil, as would be expected, contains less organic matter than the soil. It also has more of the finest soil particles, fine silt and clay; aside from this the soil and subsoil do not differ materially.

The samples of soil were taken from 0 to 8 inches, the subsoil from 8 to 24 inches.

According to the plan of the test, Plot 1 was left without cultivation. Plot 2 was cultivated twice per week up to July 31, and again August 6.

Plot 3 was cultivated twice after the beginning of the experiment. On the 22nd of July the weeds were cut with a hoe from all of the plots, without stirring the soil.

To determine the amount of moisture in the soil, samples were taken with a section of one and one-fourth inch gas pipe fitted at one end with a tool steel edge, in the inside of which there was a rim which reduced the diameter at that point to one and one-eighth inches. This cutting edge was attached to the gas pipe by means of a piece of brass tubing one end of which fits into the cutting edge of the gas pipe while the other is inserted into the end of the section of gas pipe which has been bored out for the purpose. The core of soil, being smaller in diameter than the bore of the gas pipe, is readily emptied from the opposite end of the tube into the tin dish used for carrying the sample to the laboratory. These dishes are six inches in diameter, two inches deep and fitted with screw covers which make them practically air tight. At the laboratory the dishes containing the samples of soil are weighed and placed, after the covers are removed, in a drying closet, heated by steam. Here the moisture is rapidly driven off. As soon as thoroughly dried and cool the dishes, still containing the dried soil, are weighed. The difference between the first and second weight is the amount of water in the original sample. By placing the sample of soil, at the moment of taking it in the field, into an air-tight dish from which it is not removed until after its weight is determined, all opportunity for a loss of moisture is removed.

The soil samples were taken from the center row of each plot, the samples for the given day being taken on the same cross row, in order that they might be as near together as possible and hence more comparable. The sampling was begun at the east end of the plot and progressed regularly westward. The samples were taken in foot sections and in duplicate, the average of the duplicates being reported as the per cent of moisture for the given determination. The variation between these duplicates was usually very small. The samples were taken three times a week as a rule. Twice a week the samples were taken to a depth of one foot only and once per week to a depth of three feet, keeping separate the samples for each foot in depth. The table given below shows the average per cent and the average weight of water per cubic foot in the three different plots, and for intervals of one foot in depth up to three feet. In the first column under each plot is given the average per cent of moisture in the first, second and third foot for the season, in the second column the weight of water per cubic foot on the average, for the entire time covered by the experiment.

Water content of three corn plots.

	Plot 1, uncultivated.		Plot 2, cultivated twice a week.		Plot 3, ordinary cultivation.	
	Per cent.	Lbs. per cubic foot.	Per cent.	Lbs. per cubic foot.	Per cent.	Lbs. per cubic foot.
1st foot	12.70	11.18	14.91	13.12	14.79	13.02
2nd "	12.55	12.30	12.99	12.73	12.22	11.97
3rd "	14.51	14.22	14.86	14.56	15.18	14.87

For each square foot of horizontal area and to a depth of three feet, Plot 1 had 37.70 pounds of water; Plot 2, 40.41 pounds, and Plot 3, 39.86.

It may seem that the differences in moisture content as shown in the table are not large enough to be of practical importance; there is but an increase of 5.83 per cent in Plot 3 and 7.26 per cent in Plot 2 over the uncultivated plot. It must be remembered, however, that not all of the water that a soil contains is available for crop production. According to King, (Wis. Report 1893, page 178) growth ceases on a sandy soil when it contains but 6 % of moisture and on a clay soil when it contains but 9 %. The soil on which this experiment was tried was a loam intermediate between sand and clay and would retain probably 7.5 % unavailable moisture. For the upper three feet this would be 21.3 pounds of water per square foot of horizontal area. According to this calculation the amount of water in each plot to a depth of three feet for each square foot of area available to plants would be: Plot 1, 16.4 pounds, Plot 2, 19.11 pounds and Plot 3, 18.56 pounds. Using the available moisture of Plot 1 as a basis we have in Plot 2, 16.52 per cent and in Plot 3, 13.17 % more available moisture than in Plot 1.

As no weeds were allowed to attain any considerable size on these plots, one great loss of moisture on ordinary uncultivated land was entirely obviated. Again, all the plots had thorough cultivation until the beginning of the experiment, June 25th. When these facts are considered it is significant that so much more moisture was found in the cultivated plots than in the uncultivated that of the plot receiving ordinary cultivation being especially noteworthy.

The size of the crop depends very largely upon the water supply. In moist years, where the rainfall is ample and well distributed through the season, the corn crop is large whether the cultivation is attended to or not. It is in the dry year that the skill of the farmer reaps its reward. By cultivation at the right times, to the proper depth and with the proper implements he is able to hold the rainfall, prevent its escape and utilize it in the maturing of a crop which would otherwise be a comparative failure. The profit on a corn crop often hinges on the presence of the last per cent of available moisture and the efforts of the farmer are directed towards its conservation.

Diagram No. 1 will show the variations in the per cent of water in the top foot of each plot throughout the season. The effects of rains and of excessively dry weather should be noted. The latter is shown by the line marked relative humidity, the lower this line the drier the atmosphere.

Diagram No. 2 shows the average per cent of moisture to a depth of three feet in each of the plots. Perhaps the most striking feature of this diagram is the absence of excessive variation in the amount of moisture in Plot 2. On this point Prof. Milton Whitney writes in the Year Book of the Department of Agriculture for 1895, page 124, "Water is thus conserved for the use of crops and the supply is more abundant and more uniform than it would have been without cultivation," also: "A soil with a compact surface quickly dries out and the water supply fluctuates rapidly and excessively to the detriment of most crops during the growing period."

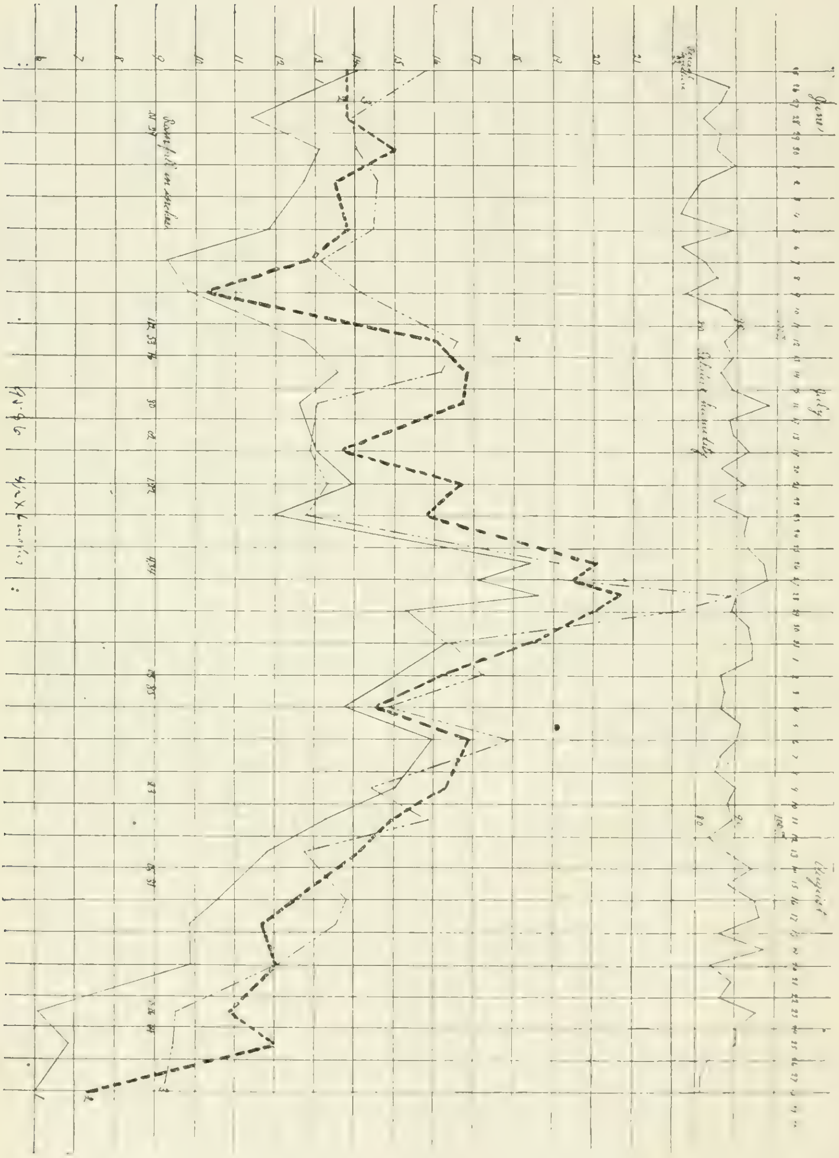

DIAGRAM I.—Moisture in first foot.—Line 1 (unbroken) per cent moisture in uncultivated plot; line 2 (heavy broken), per cent moisture in frequently cultivated plot; line 3 (light and broken), per cent moisture in plot under ordinary cultivation. Line of relative humidity shows the air to be very dry when it approaches or goes below 80 per cent. Very moist when it reaches or goes above 90 per cent.

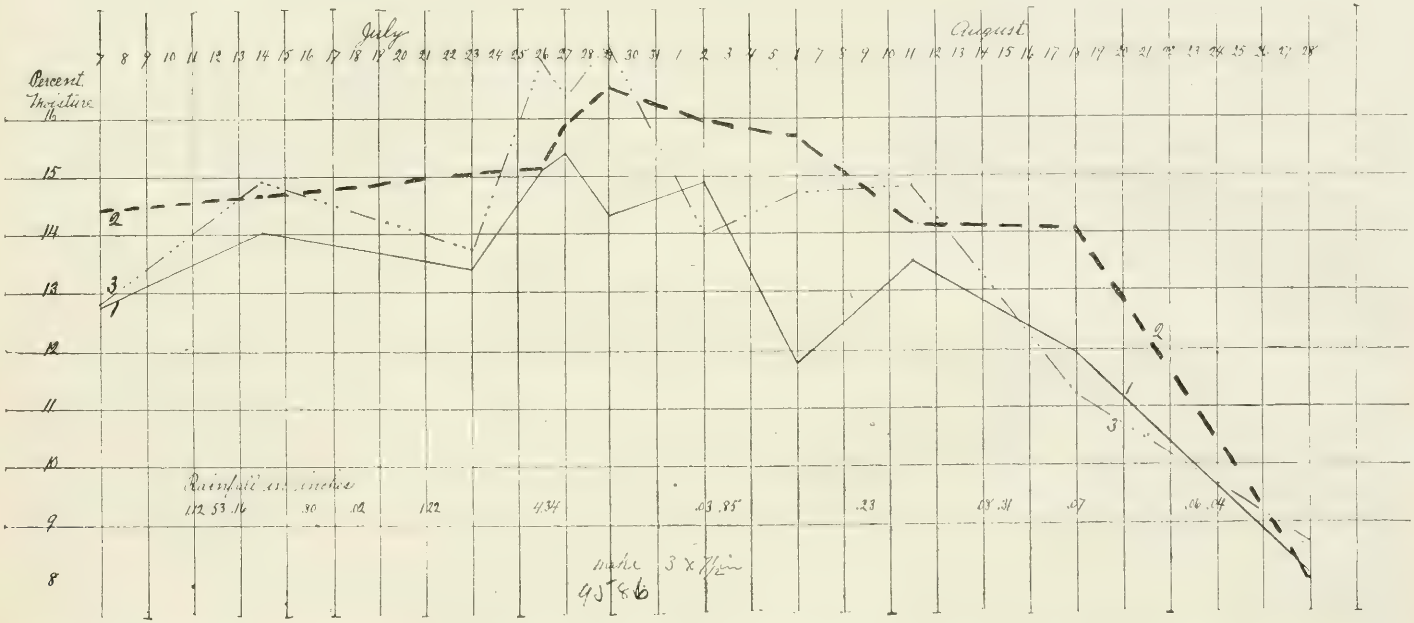

DIAGRAM II.—Average moisture to a depth of three feet. -Line 1 (unbroken), moisture in uncultivated plot. Line 2 (heavy and broken), moisture in frequently cultivated plot. Line 3 (light and broken), moisture in plot receiving ordinary cultivation

The next table is inserted to record the per cents of moisture found in the various samples through the progress of the experiment.

Cultivation experiment, field No. 8. Per cent of moisture.

Date.	Plot 1, uncultivated.			Plot 2, cultivated twice a week.			Plot 3, Ordinary cultivation.		
	1st foot. Per cent.	2d foot. Per cent.	3d foot. Per cent.	1st foot. Per cent.	2d foot. Per cent.	3d foot. Per cent.	1st foot. Per cent.	2d foot. Per cent.	3d foot. Per cent.
June 25	14.09	----------	----------	13.80	----------	----------	15.78	----------	----------
28	11.40	----------	----------	13.80	----------	----------	13.93	----------	----------
30	13.31	----------	----------	15.00	----------	----------	14.05	----------	----------
July 2	12.72	----------	----------	13.54	----------	----------	14.57	----------	----------
5	11.84	----------	----------	13.85	----------	----------	14.47	----------	----------
7	9.31	13.83	15.22	12.86	13.98	16.40	13.18	10.71	14.53
9	9.82	----------	----------	10.29	----------	----------	14.13	----------	----------
12	12.76	----------	----------	16.05	----------	----------	16.60	----------	----------
14	13.57	13.60	14.98	16.84	13.57	13.49	15.99	13.19	15.61
16	12.51	----------	----------	16.74	----------	----------	13.08	----------	----------
19	13.05	----------	----------	13.56	----------	----------	12.88	----------	----------
21	13.93	----------	----------	16.68	----------	----------	13.34	----------	----------
23	11.97	14.87	13.28	15.81	13.93	15.38	12.81	12.14	16.27
26	18.41	11.62	15.20	20.09	11.34	13.87	19.14	14.15	17.72
27	17.10	12.59	16.44	19.47	14.22	13.82	19.15	13.54	16.41
28	18.62	----------	----------	20.71	----------	----------	23.46	----------	----------
29	15.29	11.77	16.47	20.14	12.01	17.45	22.12	13.97	15.66
31	16.35	----------	----------	18.56	----------	----------	16.43	----------	----------
August 2	15.05	14.96	14.60	16.30	16.56	15.07	17.21	11.17	13.60
4	13.77	----------	----------	14.59	----------	----------	14.84	----------	----------
6	15.94	----------	----------	16.92	13.38	16.82	17.88	11.03	15.16
9	15.00	----------	----------	16.36	----------	----------	14.41	----------	----------
11	13.32	11.51	15.83	14.94	11.65	15.99	15.84	12.49	16.10
13	11.79	----------	----------	14.09	----------	----------	12.77	----------	----------
16	10.56	----------	----------	12.49	----------	----------	13.81	----------	----------
18	9.85	12.94	13.06	11.64	14.80	15.85	13.55	----------	----------
20	9.87	----------	----------	12.02	----------	----------	12.04	----------	----------
23	6.08	----------	----------	10.82	----------	----------	9.50	----------	----------
25	6.81	----------	----------	11.94	----------	----------	9.41	----------	----------
28	5.97	8.49	10.06	7.27	7.43	9.37	7.29	9.86	8.78

THE LEAVES, STALKS AND EARS.

The next question to be considered is the relative value of the leaves, stalks, and ears and the changes that take place in their composition as the crop approaches maturity. The idea obtains so widely in this State that the sole use of the corn crop is to furnish the grain and that the food value of the stalk and leaf is relatively insignificant that it seems worth while to study this matter quite thoroughly and to make chemical analyses of the leaves, stalks and ears at different stages of the growth of the plant. These experiments were begun in 1896 and partially repeated in 1897.

In 1896, on August 24th, August 31st, September 7th, and September 14th, 100 stalks were taken from the corn field, the leaves stripped off, the corn husked, and the stalks, the ears, and the leaves including the husks were weighed separately. The results were as follows:

Weights of leaves, stalks and ears of 100 plants, 1896.

	Total weight. Lbs.	Leaves. Lbs.	Stalks. Lbs.	Ears. Lbs.	
August 24	201.75	85.	67.75	49.	In milk.
August 31	195.00	76.	66.5	52.5	Roasting ears.
September 7	210.25	82.	69.5	59.75	Glazed.
September 14	176.5	49.5	64.	63.	Ripe.

It was manifestly impossible to select at the beginning of the experiment, four hundred stalks that should grow so evenly that those cut at the different intervals would fairly represent the stage of growth in the field at large at the given time, the number taken was too small for that. It was fair to assume, however, since representative stalks were taken, that these plants so selected would give a clue as to the changes that were taking place in the relation of parts. Dividing, therefore the weight of the leaves, of the stalks and of the ears separately by their united weight for the given date we get the per cent of the gross weight of the plant that was resident in the leaves, stalks and ears respectively, hence this table which shows the per cent of the whole weight found in each part.

Per cent of total weight found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	42.13	33.57	24.30
August 31	38.98	34.10	26.92
September 7	39.00	33.66	27.34
September 14	28.04	36.26	35.70

It is not the total weight that interests us, however, but the proportion of dry matter that is found in the leaves, stalks and ears respectively. Hence in the chemical analysis each part was thoroughly dried and the following table shows the proportion of the dry matter of the whole plant that was included in each part.

Per cent of total dry matter resident in leaves, stalks and ears, respectively.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	36.41	34.27	29.32
August 31	33.63	25.52	40.85
September 7	30.03	25.53	44.44
September 14	21.77	31.91	46.32

The relation of the weight of the stalk to that of the entire plant remains about constant. The relative weight of the ear increases rapidly while that of the leaf as rapidly decreases. Nevertheless less than half of the total dry matter in the plant when fully ripe is in the ear, nearly a third of it is in the stalk and over a fifth is in the leaves.

Going back in the history of the plant, it is to be noted that as far as dry matter was concerned, on August 24th, when the corn was in the milk, a little more than a third of the food material was contained in the leaves, a slightly less proportion in the stalks and still less in the ears. A week later, on August 31st, while still more than a third of the dry matter was in the leaves there was but practically a quarter of it in the stalks and slightly over forty per cent in the ears which were evidently growing partially at the expense of the stalk. A week later when the corn was just glazing the leaves contained less than a third, the stalks a quarter and the ears 44 % of the dry matter of the crop. Even when fully matured and ready to harvest over 53 % of the dry matter was in the stalks and leaves and but 46.32 % in the ears.

Undoubtedly the most valuable single nutrient in the corn is the protein. The following table shows the distribution of the protein at the different dates:

Per cent of the total protein content of corn plant found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	52.70	16.00	31.30
August 31	44.69	10.95	44.34
September 7	40.69	9.38	50.00
September 14	32.30	17.10	50.60

In all the earlier stages of growth, the greater share of the protein is found in the leaves; and even when the corn is ripe enough to cut, but little over half of it is found in the ears. This fact calls attention again to the necessity of carefully housing and preserving the fodder.

The next table which gives the distribution of the albuminoid nitrogen should be studied in connection with the one just given, relating to the total protein.

Per cent of total content of Alb. N. found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	52.50	10.00	37.50
August 31	51.06	2.53	46.41
September 7	42.71	5.19	52.10
September 14	30.60	10.70	58.70

It seems that when the corn is in the roasting ear and the whole plant is vascular but 2.53 % of all the albuminoid nitrogen in the plant is resident in the stalks, even at this date nearly half of the albuminoid nitrogen of the entire plant is found in the ear, immature as it is. When the crop is ready to cut nearly sixty per cent of the albuminoid nitrogen is found in the ear.

Turning now to the class of soluble non-nitrogenous substances included, by the chemists, under the term nitrogen-free extract and containing such nutrients as starch and sugar the following table shows how their distribution changes at the four dates given.

Per cent of the total content of N. free extract found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	38.50	17.50	44.00
August 31	28.40	23.64	47.96
September 7	20.50	25.30	54.20
September 14	15.90	29.40	54.70

It is manifest that the soluble carbo-hydrates are found very largely in the leaves and ears while the ears are in the milk or in the roasting stage. At periods later over half of the starch and sugar is found in the ears and when the corn is fully ripe about twice as much is found in the stalks as in the leaves.

While it is a matter of subordinate interest, the following table is given to show the movement of the ash, as the plant develops.

Per cent of total content of ash found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 24	42.89	23.76	10.17
August 31	54.04	25.94	20.02
September 7	59.80	21.30	18.90
September 14	50.00	32.60	17.40

It is interesting to note that later than August 31, more than half of all the mineral elements existing in the corn resides in the leaves. During the last week between September 7, and September 14, the leaves lose part of their ash which finds its way into the stalks. The latter contain from a quarter to a third of the total ash of the plant. The ears are relatively weak in ash.

The next table gives the chemical composition of the dry matter of the leaves, stalks and ears of the dent corn whose history has just been partly gone over, at the four dates, August 24, August 31, September 7, and September 14, at which latter date the corn was glazed and dented and fully ready to harvest.

Composition of dry matter of leaves, stalks and ears of dent corn at different dates.

	Dry matter Per cent.	Total N Per cent.	Alb. N. Per cent	Fat. Per cent	Ash. Per cent.	Crude fiber. Per cent.	Protein. Per cent	N. free extract. Per cent.
August 24:								
Leaves	21.54	1.96	1.52	1.98	8.07	28.71	12.25	48.99
Stalks	25.25	.64	.31	1.11	4.79	33.79	4.00	57.31
Ears	30.31	1.43	1.30	3.34	2.33	15.29	9.94	69.10
August 31:								
Leaves	21.56	1.59	1.48	1.69	7.01	29.74	9.94	51.62
Stalks	18.69	.52	.10	1.22	4.44	33.67	3.25	57.42
Ears	37.90	1.30	1.11	4.28	2.14	13.71	8.13	71.74
September 7:								
Leaves	22.53	1.61	1.38	1.91	8.78	27.26	10.06	51.99
Stalks	22.59	.43	.20	1.05	3.81	32.32	2.69	60.13
Ears	44.09	1.34	1.14	4.60	2.14	10.98	8.38	73.90
September 14:								
Leaves	27.27	1.71	1.39	2.05	10.92	31.45	10.69	44.89
Stalks	21.53	.41	.33	1.36	4.84	34.55	2.57	56.68
Ears	45.57	1.34	1.25	4.79	1.75	12.02	8.38	73.06

The next table gives the analyses of the dry matter of the leaves, stalks and ears of sweet corn, grown in 1896 on the dates given, viz., August 25th, September 1st, September 8th, and September 15th.

Composition of the dry matter of the parts of sweet corn at four different dates.

	Dry matter Per cent.	Total N. Per cent	Alb. N Per cent.	Fat. Per cent.	Ash. Per cent.	Crude fiber. Per cent.	Protein. Per cent	N free extract, Per cent.
Aug. 25:								
Leaves	24.95	1.91	1.46	2.87	8.78	26.37	11.91	51.04
Stalks	20.95	.78	.58	1.62	6.21	33.03	4.88	54.26
Ears	32.08	1.55	1.44	5.73	2.38	11.93	9.69	70.27
Sept 1:								
Leaves	30.13	1.42	1.13	2.58	8.88	27.83	8.90	51.81
Stalks	19. 9	.83	.37	1.14	5.93	27.78	5.17	59.98
Ears	35.11	1.31	1. 9	7.39	2.51	10.43	8.18	71.49
Sept 8:								
Leaves	33.77	1.38	.87	2.04	7.91	29.41	8.63	52.01
Stalks	21.83	.93	.47	1.00	5.29	28.89	5.8	59.01
Ears		1.79	1.57	7.63	2.25	10.44	11.23	68.45
Sept. 15:								
Leaves	32.8	1.31	1.13	1.88	14.46	29.81	8.19	45.66
Stalks	18.68	1.05	.64	2.15	6.09	31.16	6.57	54.03
Ears	46.22	1.92	1.84	7.08	1.99	11.91	12.00	68.02

The foregoing table would be comparatively valueless without the weights of the different parts of the plants were also known, hence the following table:

Weights of the several parts of sweet corn at four different dates.

	Leaves. Lbs.	Stalks. Lbs.	Ears. Lbs.	Total. Lbs
August 25	61.75	52.50	60.5	174.75
September 1	58.5	50.	63.5	172.
September 8	45.5	43.5	50.	139.
September 15	43.5	50.	56.5	150

To secure representative samples of the sweet corn at the different dates similar stalks were taken from every fourth hill until a hundred stalks were secured. They were weighed and treated in the same way that the dent corn was, the ears, bare stalks and the leaves and husks being weighed separately and samples taken for analysis.

Taking up first the dry matter, the next table shows the per cent of the total dry matter in the plants as a whole that was found in the leaves, stalks and ears respectively at the different dates.

Per cent of total content of dry matter found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks Per cent.	Ears. Per cent.
August 25	33.63	24.00	42.37
September 1	35.15	19.78	45.07
September 15	28.70	18.78	52.52

Here again it is shown that the ears when the corn is fully ripe contain but little more than half the dry matter of the entire plant. The leaves of sweet corn contain more than a quarter of the dry matter and the stalks less than a fifth. It is important therefore that in harvesting this crop for forage due attention be paid to the preservation of the dry matter of the leaves.

Turning to the protein, the next table gives the relative proportions of the total protein content of the plant that are found in the different parts of the plant at the different dates.

Per cent of total protein content found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 25	43.18	12.63	44.19
September 1	40.34	12.75	46.91
September 15	23.80	12.46	63.74

The growth of the ear at the expense of the other parts of the plant is conspicuous and the fact that when ripe the leaves contain 23.80 per cent of all the protein in the plant is worthy of notice. In this case as in the case of the dent corn already studied the leaves include the husks. Of the albuminoid nitrogen the ear when ripe contains less than half and the leaves 36.60 %.

Finally examining the distribution of the N. free extract at the several dates the following table results:

Per cent of total content of N. free extract found in leaves, stalks and ears.

	Leaves. Per cent.	Stalks. Per cent.	Ears. Per cent.
August 25	28.63	21.70	49.67
September 1	29.66	18.48	51.86
September 15	22.23	17.21	60.56

The ears are rich in starch and sugar but not as rich relatively in these constituents as in protein as shown above.

In the summer of 1896 a field of sorghum was making an apparently unusual growth and it was determined to carry on the same line of experimentation with this crop as with the corn. Four representative stalks from every fourth hill were therefore selected up to the number of 100 stalks, on the same four dates as were taken in the sweet corn experiment. The tops were cut off with as little stalk as possible, the leaves were stripped and the leaves, stalks and tops weighed separately. The following table gives the weights of these different parts on the dates indicated:

Weights of leaves, stalks and tops of sorghum.

	Leaves. Lbs.	Stalks. Lbs.	Tops Lbs.	Total. Lbs.
August 25	17.5	81.75	5.25	104.5
September 1	17.	70.00	5.05	92.5
September 8	20.5	77.5	7.25	105.
September 15	22.	78.5	8.5	109.

The analyses of the samples taken on each of these dates are reported in the next table.

Chemical composition of the dry matter of leaves, stalks and tops at four dates in 1896.

	Dry matter Per cent.	Total N. Per cent.	Alb. N. Per cent	Fat. Per cent	Ash. Per cent	Crude fiber. Per cent	Protein. Per cent.	N. free extract. Per cent.
August 25:								
Leaves	27.34	2.21	1.67	4.34	9.19	31.49	13.81	41.17
Stalks	19.84	.46	.22	1.04	4.71	28.87	2.87	62.51
Heads	36.67	1.82	1.49	2.48	6.23	21.91	11.48	67.90
September 1:								
Leaves	24.95	1.95	1.69	3.97	9.23	31.13	12.19	43.48
Stalks	22.09	.29	.18	.63	3.49	28.34	1.82	65.72
Heads	42.57	1.65	1.44	3.09	5.03	12.19	10.30	69.39
September 8:								
Leaves	22.62	1.96	1.37	3.77	8.68	32.09	12.25	43.21
Stalks	21.82	.32	.17	1.04	3.67	28.67	2.00	64.62
Heads	---------	1.76	1.13	3.15	4.77	13.92	11.00	67.16
September 15:								
Leaves	22.43	1.94	1.33	3.57	11.74	30.85	12.13	41.71
Stalks	24.19	.21	.21	1.44	3.20	26.55	1.31	67.50
Heads	45.60	1.71	1.54	3.56	4.80	13.09	10.69	67.86

Following with the sorghum the plan adopted with the dent and sweet corn the next table gives the per cent of all of the dry matter in the plant that is found in the leaves, stalks and tops, respectively at the different dates.

Per cent of total dry matter in sorghum plants found in leaves, stalks and tops.

	Leaves. Per cent.	Stalks. Per cent.	Tops. Per cent.
August 25	20.85	71.07	8.08
September 1	20.85	68.74	10.41
September 15	17.11	65.93	16.96

As was to be expected the bulk of the dry matter of the sorghum plant is found in the stalks. The content of the leaves and tops when the plant is matured is about equal.

The next table gives the distribution of the protein:

Per cent of total protein content of sorghum plants found in leaves, stalks and tops.

	Leaves. Per cent.	Stalks. Per cent.	Tops. Per cent.
August 25	54.08	28.06	17 86
September 1	52.60	25.43	21 96
September 15	45.56	19.80	34.64

The stalks of sorghum are conspicuously low in nitrogen. Notwithstanding the fact that over 65% of the dry matter of the plant was found in the stalks, 45.56% of the protein is found in the leaves and less than a fifth of it is in the stalks. Here again the necessity of carefully husbanding the leaves is apparent. If we were to look at the albuminoid nitrogen alone we should find 39.33 % of the total content of this constituent in the leaves, 36.38 % in the tops and 24.29 % in the stalks.

The most abundant nutrient in sorghum is the nitrogen free extract containing the sugar. The distribution of this group of nutrients in the different parts of the sorghum is shown in the next table:

Per cent of total content of N. free extract of sorghum plant found in leaves, stalks and tops.

	Leaves. Per cent.	Stalks. Per cent.	Tops. Per cent.
August 25	11.86	75.78	9.36
September 1	14.77	73.51	11.72
September 15	11.74	73.39	14.88

Nearly three-quarters of the starch, sugar and other soluble carbohydrates is thus found in the stems of the sorghum, when the plants are mature. As the analyses reported in the table above show, the leaves and heads are relatively rich in protein and ash.

EXPERIMENT IN 1897.

In 1897 the question of the relative development of the ears, stalks and leaves was again studied, the corn being taken from Field 8. Four examinations were made, the first August 10th, as the corn was just tasseled out, the second August 25th, when the ears were going into the roasting stage, the third September 6th, when the kernels were beginning to glaze and the fourth September 15th, when the corn was fully glazed and ripe. The weights of the leaves, stalks and ears on those dates are recorded in the next table. Two hundred stalks were used in each case.

Weights of leaves, stalks and ears of 200 stalks dent corn, 1897.

	Leaves. Lbs.	Stalks. Lbs.	Ears. Lbs.	Total. Lbs.
August 10	184	187.5	22.5	394
August 25	197	207.5	110.5	515
September 6	181	191.75	150.	522.75
September 15	128.5	163.5	154.75	446.75

The weather was very dry and hot after the first of August, and there is no increase in the gross weight of the corn plant. This is shown by the fact that on August 10th, 1,311 cornstalks bearing ears, weighed 2,938 pounds or an average of 2.09 pounds per plant. On August 25th, 1,329 stalks weighed 3,296 pounds or an average of 2.5 pounds per plant; on September 6th, 1,352 stalks weighed but 3,340 pounds or an average of 2.48 pounds per plant and on September 15th, 1,308 stalks weighed 2,954 pounds or but 2.26 pounds per stalk. The corn field was therefore bearing its largest gross weight of corn on August 25th, when the ears were in the early roasting stage. It does not follow, however, that at that time there was present the greatest amount either of dry matter or of valuable feeding material.

The dry matter was determined in the leaves, stalks and ears of the two hundred sample plants on these different dates. In the next table there is given the pounds of dry matter in each of these parts of the plant on the given dates.

Weight of dry matter in leaves, stalks and ears of 200 stalks of dent corn.

	Leaves. Lbs.	Stalks. Lbs.	Ears. Lbs.	Total. Lbs.
August 10	34.48	31.74	1.69	67.91
August 25	52.36	48.91	26.20	127.47
September 6	53.65	44.85	56.37	154.87
September 15	42.77	38.13	71.56	152.46

While there is an apparent loss in total dry matter between September 6th and September 15th, there is at the same time a gain of dry matter in the ears and a corresponding loss in the leaves and stalks. This loss in the leaves is due to a transfer of part of their substance through the stalk to the ear and to an actual loss of dry matter by oxidation as the leaves mature. Later in the bulletin complete analyses of samples of corn taken for silage on these dates will be given. September 15th, when the corn was fully ripe less than half the dry matter was in the ears, the other half being about equally divided between the stalks and leaves.

The Pennsylvania Station performed some experiments along this line in 1887 and 1888, the results of which are published in the Report of that Station for 1888 and in Bulletin 11 of the same Station published in 1890. A table and comments taken from page 13 of the bulletin follows:

"That the relative distribution of the dry matter may be more easily seen the following table has been calculated from the above. It shows that out of every hundred pounds of dry matter in the plant there is, in the different parts, the number of pounds given in the table. It also shows the proportion of total amount in ears and stover, the ears being taken as the unit."

Proportion of parts, 100 pounds of dry matter is distributed.

Name of variety.	Ears.		Stover.			Total.	Proportion of ears to stover.
	Corn.	Cob.	Leaves and husks.	Butts.	Tops.		
Flints:							
Angel of Midnight	52	9	29	7	3	100	1: .64
Longfellow	55	9	26	8	2	100	1: .56
Pipe Stem	33	7	48	11	1	100	1:1.51
Self Husking	57	10	23	7	3	100	1: .48
Dents:							
Champion White Pearl	42	10	27	18	3	100	1: .91
Cleaver	44	10	28	14	4	1 0	1: .83
Golden Beauty	32	9	38	15	5	100	1:1 43
Golden Dent	30	8	33	22	7	100	1:1 62
Hickory King	30	5	38	20	7	100	1:1.83
Leaming	40	10	29	15	6	100	1:1.72
Plasa Queen	34	9	32	18	7	100	1:1.77
Queen of the North	50	8	28	10	4	100	1:1.49
Queen of the Prairie	43	10	27	14	6	100	1:1.73
Wisconsin Earliest White Dent	51	12	25	8	4	100	1:1.48

"The results show that fully half of the valuable dry matter is contained in the ears and of this nearly one-fifth is in the cob. The leaves and husks contain from one-fourth to one-third of the total and there is four to five times as much of the remainder in the butts or harder and tougher parts, as in the tops. Thus, when fodder is fed whole, there is more or less waste of the butts by the animal. From our results it would seem that this loss would be from 7 to 22 pounds in every 100 pounds of dry matter. Practical experience has proved that much of this can be saved by cutting up the cured fodder or putting it in the silo."

Analyses of the different parts of the corn plant at the Wisconsin Experiment Station in 1889 show "that nearly 50 per cent of the dry matter, and over 30 per cent of the protein in fodder corn is present in the much neglected stalk. No farmer can afford to allow so large a proportion of his crop to be wasted as it is in the present methods of feeding in the field."

The tables recorded above show conclusively that the leaves of dent and sweet corn and of sorghum contain a very large proportion of the total food constituents of the entire plant. They should be preserved as well as the ears and stalks. Exposure to wind and rain soon destroys the value of these parts of the fodder by destroying the sugar.

The studies in the changes that take place in the distribution of nutrients in the corn plant give us a hint that the total amount of nutriment in an acre of corn is greater at one time than at another. It is important for the farmer to have some guide as to the stage of growth at which his cornfield contains the greatest amount of actual food value. If the corn is to be stored in the silo another question presents itself. It is not enough to know at what stage of growth the corn contains the greatest amount of nutriment unless it is shown at the same time that, if stored in the silo at that stage of growth, there is a relatively less or at least not greater loss by fermentation that would occur had the corn been cut earlier or allowed to become more mature. There are therefore two phases of the question of the time to harvest silage on which experiments have ben tried at the Station and which will be discussed in order. First, at what stage of the growth of the corn plant does it contain the largest amount of cattle foods, and second, what differences are there in the losses that occur in the silo due to the stage of ripeness of the corn when cut.

WHEN DOES CORN CONTAIN THE LARGEST AMOUNT OF NUTRIMENT?

One of the chief difficulties in carrying out an experiment to answer a question of this kind is to find areas to be cut at successive intervals which shall be in all respects alike. If in the regular cornfield adjacent areas of equal size are laid aside for the test, then it will be found that differences in the quality of the land, irregular working of the corn planter, unequal distribution of the devastations of grubs and insect pests, and various other causes will have combined to make the number and size of the hills on one area greater or less than on the others. It was decided to compare the corn at four stages of growth: First, when fully tasseled and the silks appearing; second, when just going into the roasting stage; third, when beginning to glaze and going out of the roasting stage, and fourth, when all kernels were fully glazed and some of the ears were dead ripe. An area of something over half an acre was set aside for the experiment, in Field No. 8. The corn had been planted with a check rower in hills three feet and nine inches apart each way. The sizes of the kernels of the seed corn had varied and hence there were more stalks in some hills than in others, and there were occasionally blanks where the planter had failed to work. Eighty rows running east and west were used in the experiment. In cutting the corn, two hundred hills were drawn to the barn at a load and the stalks counted. If hills were found containing but a single stalk, or if by reason of smut or some other disease the hill was abnormally small or defective, such hills were omitted. The cuttings were made August 10 and 25, and September 6 and 15. On August 10, the first, fifth, ninth, thirteenth and every fourth row thereafter were cut, until twenty rows had been cut. Twenty hills were cut in each row. On August 25, the second, sixth, tenth, fourteenth, and each fourth row therafter, were harvested. In this way it was thought that the corn cut at the successive intervals would be drawn from all parts of the area and the conclusions from the comparisons of their different weights and behavior would be fair and warranted.

In trying to avoid the disturbing elements of variations in the productiveness of the soil and other factors that would have entered in had the corn been cut on distinct but adjacent areas on the different dates, another influence was introduced whose importance cannot be calculated. After August 25, two rows were left standing with two rows on each side cut away. This admitted the sunlight freely to the plants in these rows and caused them to mature somewhat more rapidly and more fully than would have been the case had all the ground been occupied. It was noted, especially at the time of cutting the last quantity on September 15, when one row had been left standing for nine days with three rows vacant on each side that the corn was distinctly drier and more mature than in the near-by general field.

The corn was weighed at each date in two separate lots of two hundred hills each. The number of stalks in each lot at each date, the weight of each load and the average weight per stalk in each case is given below.

Weights of 200 hills, average weight of single stalks, and weights of 400 hills at different dates.

Date.	Load.	No. of stalks.	Weight. Lbs.	Av. weight per stalk. Lbs.		Total stalks.	Total weights. Lbs.
Aug. 10	1	683	1,358	1.98	2.09	1,311	2,738
	2	628	1,380	2.20			
Aug. 25	1	696	1,620	2.32	2.48	1,329	3,292
	2	633	1,672	2.64			
Sept. 6	1	726	1,719	2.[illegible]	2.49	1,352	3,310
	2	626	1,621	2.59			
Sept. 15	1	699	1,484	2.12	2.28	1,308	2,971
	2	609	1,487	2.44			

As was to be expected, the fewer the number of stalks in the two hundred hills the greater the weight per stalk. It is to be noted also that the absolute weight of the two hundred hills containing the fewer number of stalks was greater August 10 and August 25, and that on September 15, when there were ninety stalks more in one two hundred hill lot than in the other, the difference in absolute weight was only three pounds. There seems to be a strong indication, as far as this experiment bears on the point, that as far as gross yield per acre is concerned, three stalks per hill under the conditions here existing are sufficient.

Samples were taken for chemical analysis by selecting at each date fifteen stalks as nearly representative of the average plants as possible. These specimen stalks were run through a cutting box, dried, again sampled and analyzed. The results of that analysis are reported on page 285 in connection with the composition of the silage from the corn cut on the several dates.

The next table shows the weight of the corn as cut, less the weights of the 15 stalks taken for analysis, the amount of dry matter and of the various nutrients in the 400 hills of corn cut on the several dates.

Dry matter and nutrients in 400 hills of corn, 1897.

Date.	Green fodder. Lbs.	Dry matter. Lbs.	Total N. Lbs	Alb. N. Lbs.	Amide N Lbs.	Protein. Lbs.	Fiber. Lbs.	N free extract Lbs.	Fat. Lbs.	Ash Lbs.
August 10	2,709	468.92	9.65	6.98	2.67	60.39	129.04	233.56	8.67	37.23
August 25	3,246	677.44	10.50	9.01	1.49	65.70	146.25	409.03	18.22	38.20
September 6	3,297	906.35	14.50	12.51	1.97	90.63	165.05	580.52	25.38	44.67
September 15	2,934	1,022.79	14.21	12.58	1.63	88.88	180.21	683.12	30.99	39.58

The increase in total weight of green corn was not as regular and constant as the increase in dry matter. The intervals between the successive dates were not of the same length, and the weather between September 6 and 15 was exceedingly dry and hot, much more so than between the other dates. The amount of water in the stalks would therefore be expected to be much less on the last date than upon either of the others. Between August 10 and 25, the temperatures were low and the weather moist, hence the corn ripened slowly and it was necessary to make the period long to allow for the change in the ear and stalk.

The area represented by the 400 hills was .1291 acre.

Calculating, from the data already given, the yields of dry matter and nutrients per acre, we have the following table:

Yields per acre of green fodder, dry matter and nutrients.

Date.	Green fodder. Lbs.	Dry matter. Lbs.	Protein. Lbs.	N. free extract. Lbs.	Fat. Lbs.	Fiber. Lbs.	
August 10	21,203	3,670.24	472.73	1,828.15	67.90	1,010.05	Tasseled.
August 25	25,493	5,320.39	576.08	3,212.45	143.11	1,148.67	Roasting.
September 6	25,865	7,110.29	711.03	4,554.14	199.08	1,294.78	Glazing.
September 15	23,007	8,020.24	696.96	5,356.72	242.61	1,413.17	Ripe.

There was a rapid and regular increase in gross weight of the crop per acre up to the time of glazing, when the field bore as heavy a crop as at any period either earlier or later. Thereafter the changes were not in increased weight, but in the displacement of water by dry matter. The intervals between the different dates on which the samples were taken were not regular. Attention was paid not to the calendar but to the condition of the corn. Between the time when the corn was fully tasseled and when the ears were in the early roasting stage there was a gain of dry matter of 44 per cent. From early roasting to glazing there was a gain of dry matter of over 33 per cent, and between glazing of the kernels and full ripeness there was a gain in this respect of over one-eighth. To secure the greatest yields of *dry matter* from an acre of corn it is necessary to allow the crop to stand until fully mature with the kernels fully glazed and some of the earlier ears nearly, if not quite, ripe.

Both the albuminoid nitrogen and the total protein increase rapidly up to the time when the kernels are glazing. Thereafter there seems to be no gain in the yield of protein, although there is a slight change of the amide nitrogen to the albuminoid form.

The increase in nitrogen-free extract between early glazing and ripeness is more than one-sixth. The increase in fat in the same time is more than a fifth.

It is evident that the results of this experiment go to show that to secure the greatest yields per acre of *valuable nutrients* the corn should not be harvested until fully glazed and until the early ears are well ripened.

LOSSES IN THE SILO WITH CORN CUT AT DIFFERENT STAGES OF GROWTH.

The four hundred hills of corn cut August 10 and 25 and September 6 and 15, less the fifteen stalks in each case taken for analysis, were put in small silos as soon as harvested, running the corn first through a cutting box which cut the stalks into pieces a half inch long. These small silos were built of upright staves, held togther by steel hoops. They were six feet in diameter and ten feet deep. They were situated on the south and east sides of the cow stable, outside the barn, and hence were exposed to the severe weather of winter. It was on this account deemed advisable to empty the silos before winter set in. The silage cut August 10, was put in the bottom of silo No. 1, filling the silo about half full. As soon as put in, it was covered with a layer of building paper on which was placed a cover of two inch plank, matched, which was fitted to the silo and excluded the air except at the edges, which were covered by the building paper. A ton of pig iron was put on the cover.

The silage cut August 25 was also put in Silo No. 1. On the removal of the cover and the building paper no spoiled silage was found. The building paper was replaced to mark the division between the two lots. The silage filled the silo completely and was covered with building paper and the plank cover put on and the weights added.

In the same way the silage cut September 6th was put in the bottom of Silo No. 2, covered with building paper and a tight fitting cover, and heavily weighted. The silage cut September 15th was put into the top of Silo No. 2, removing of course the weights and wooden cover and leaving the building paper to mark the division betwen the two samples, and was covered and weighted in the same manner as Silo No. 1.

Losses of original substance and dry matter in the silo.

Date.	Corn put in. Lbs.	Taken out. Lbs.	Loss. Lbs.	Loss. Per cent.	Dry matter put in. Lbs.	Dry matter taken out. Lbs.	Loss. Lbs.	Loss. Per cent.
August 10	2,709	2,508	201	7.42	468.93	374.70	94.23	20.0
August 25	3,246	2,939	307	9.45	676.79	503.74	168.05	24.
September 6	3,297	3,100	197	6.00	906.35	706.80	199.55	2
September 15	2,934	2,626	308	10.40	1,022.79	748.67	274.12	26

Silo No. 1 was emptied November 22, and No. 2, November 27, 1897. The weights of the corn put in and the silage taken out, the per cent of loss of total substance, the weight of dry matter put in and taken out, and the per cent of loss of dry matter in each case is shown in the preceding table.

The next table gives the chemical composition of the freshly cut corn as put in the silo at the different dates, and of the silage taken out. The per cent of ingredients other than dry matter refer to the per cents of each in the dry matter.

Composition of fresh material and of the silage made from it.

Date.	Dry matter.	Composition of dry matter.						
		Nitrogen.		Protein.	Fat.	Ash.	Crude fiber.	N. free extract.
	Per cent.	Alb. Per cent.	Total Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
August 10	17.31	1.49	2.06	12.88	1.85	7.91	27.52	49.81
Silage	14.49	1.18	2.11	13.19	3.95	6.77	26.89	49.11
August 25	20.87	1.33	1.55	9.70	2.69	5.64	21.59	60.38
Silage	17.31	1.59	2.01	12.56	2.67	6.49	26.45	51.83
September 6	27.49	1.38	1.60	10.00	2.80	4.94	18.21	64.05
Silage	22.80	1.16	1.68	10.50	3.03	5.18	23.14	58.15
September 15	34.86	1.23	1.39	8.69	3.03	3.87	17.62	66.79
Silage	28 51	1.00	1.45	9.06	2.68	4.50	19.45	64.31

The next table reports the pounds of albuminoid nitrogen, protein, N. free extract, crude fibre and fat in the corn and in the silage at the different dates, and the per cent of loss in each case.

Nutrients in the original corn and in the silage.

Date.	Alb. N. Lbs.	Amide N. Lbs.	Protein. Lbs.	N. free Ex Lbs.	Crude fiber. Lbs.	Fat. Lbs.
August 10	6.98	2.67	60.39	233.56	129.04	8 67
Silage	4.42	3.48	49.42	184.01	100.75	14.80
Per cent loss	36.67	*23.27	18.16	21.21	21.92	*41.41
August 25	9.01	1.49	65.71	409.03	146.25	18.22
Silage	8.09	2.13	63.89	263.67	134.56	13.58
Per cent loss	10.21	*30.04	2.76	35.53	7.99	25.46
September 6	12.52	1.99	90.68	580.86	165.14	25.39
Silage	8.20	3.67	74.21	411.00	163.55	21.41
Per cent loss	34.50	*45.77	18.16	29.25	.95	15.67
September 15	12.58	1.63	88.88	683.12	180.21	30.99
Silage	7.48	3.37	67.87	481.46	145.61	20.56
Per cent loss	40.54	*51.63	23.65	29.54	19.19	33.65

* Gain instead of loss.

Considering together the last three tables, it is to be noted that the greatest loss of dry matter occurred with the silage cut at the latest date, September 15. The crop was at that time very dry and getting fully ripe. This fact may partly account for the excessive loss, and may indicate that the corn should be cut before so ripe as to contain too little moisture to bring about the proper fermentation. However, the losses of original substance and of dry matter were greater with the samples of silage stored in the upper halves of the two small silos than with the silage stored in the lower halves. There was a greater oxidation at the top of the silo, more of the silage had darkened by exposure to the air, and there was a descent of the juices from the upper half to the lower half of each silo. It is questionable, therefore, whether the variations in the per cent of loss of dry matter are to be attributed to the difference in ripeness of the corn when cut. Although there seems to be an increase of loss as the corn approaches maturity, it seems certain that a good share of this increment is to be ascribed to the less favorable conditions in the silo.

There is in every case a very noticeable change in the nitrogen from the albuminoid to the amide form. This change in the nitrogen seems to be a necessary concomitant of this method of storing corn. There is, moreover, a loss of total nitrogen as is shown by the per cent of loss of protein, which is the total nitrogen multiplied by 6.25. This loss varies from 2.76 per cent in the corn cut August 25 to 23.65 per cent with the corn cut September 15. The greatest loss of protein is with the corn nearly ripe. The per cent of water in this corn was 65.14, too low evidently to secure the proper changes in the silo and to prevent excessive losses.

There were no regular variations in the losses of nitrogen-free extract that could be ascribed to the condition of the corn when put in the silo. The greatest loss occurred with the corn cut August 25, and the losses were substantially equal with the two samples cut in September. The changes in fat content cannot be correctly interpreted because the composition of the substances extracted by the ether from freshly cut corn is very different from the ether extracts of the silage.

It does not appear, then, that there is any greater or less loss in the silo with later than with earlier cut corn. To secure from a field of corn the greatest yield of dry matter, of protein and of carbo-hydrates generally, the crop must be harvested when the ears are glazed, but before the stalks are dried out by drouth.

In the fall of 1889, an experiment was carried on at this Station to study the increase in dry matter made by a crop of corn from time to time after the ears had fairly begun to silk up to full ripeness. Samples of corn were cut as seven successive intervals of six days each, beginning August 10.

Two square rods were harvested at each date, the corn run through a fodder cutter and cut into half inch lengths and stored in an oak cask provided with a tight cover which was forced down by a strong screw and securely fastened. The gradual increase in dry matter as the corn matured is shown in the next table:

Note the steady increase in dry matter yielded per acre as the corn matures. Note at the same time the decrease in the loss of dry matter in the silo.

Total yield of dry matter from two square rods, 1889.

Date.	Green matter.		Dry matter.		Dry matter in silage.			Condition of corn.
	On two sq. rds. Lbs.	Per acre Lbs.	Per cent in green fodder.	Per acre Lbs.	Per cent	Per acre Lbs.	Loss per acre Lbs.	
Aug 10	240	19,200	13.90	2,672	10.00	1,920	752	In full tassel.
Aug. 16	260	20,800	15.13	3,144	12.70	2,642	502	Corn in silk.
Aug 22	273	21,840	17.40	3,712	15.60	3,407	305	Kernels fully formed.
Aug. 28	240	19,200	19.50	3,744	18.00	3,456	288	Kernels in milk
Sept. 3	212	16,960	22.56	3,824	21.40	3,629	195	Kernels still in milk.
Sept. 9	205	16,400	25.39	4,168	24.27	3,980	188	Kernels past milk.
Sept. 14	184	14,720	30.80	4,536	29.90	4,411	125	Corn glazed.

One of the earlier experiments on the question of the stage of growth at which the corn plant contains the greatest amount of nutrients was reported in Bulletin 4, of the Cornell University.

"BEST PERIOD FOR CUTTING."

"For this test, from a field of Sibley's Pride of the North corn planted in hills, fair average hills were selected at different times, cut and weighed, and the samples sent to the laboratory for analysis. At the same time a number of hills sufficient to give a fair average of the yields per acre were also cut and weighed. In this way both the yield per acre and the quality were ascertained. The corn was planted on May 7th, the first cutting was made on July 24, at which time the plants were just coming into bloom. The second cutting was made on August 8, when the corn was hardly in roasting ear condition. The third cutting was made September 3, at which time the majority of the ears were out of the milk, and in one week's time the adjoining corn was ready to cut and shock. Below are given the results:

TABLE IV.

Period.	Date of cutting.	Yield. Lbs per acre.	Per cent water.	Dry matter. Lbs per acre.	Protein. Lbs. per acre.	Fat. Lbs per acre.	Carb. hyd. Lbs. per acre.
I	July 24	18,762	89.34	2,000	250.6	42.	1,543.6
II	Aug 8	24,578	83.57	4,039	368.4	81.99	3,328.9
III	Sept. 3	27,674	73.93	7,214.2	585.8	199.10	6,166.7

There was an increase in this experiment of the yield of protein per acre of 250.6 to 585.8, and of carbo-hydrates from 1543.6 to 6166.7. The author of the bulletin estimates that the real feeding value of the corn "increased 166 per cent after it had tasseled and 80 per cent after it had nearly reached the roasting ear stage." (Cornell Bulletin 4, page 52.)

In the report of the Pennsylvania Experiment Station for 1888, page 30, it is shown that the increase in dry matter as the corn approaches maturity is very great and continues until the corn is fully ripe, that between the period of tasseling and complete ripening there was an average gain of dry matter of 155 per cent.

In 1889, at the New York Experiment Station, at Geneva, some experiments were carried on with the King Philip corn. Cuttings were made July 30, August 9, August 21, September 7 and September 23. The yields of dry matter per acre at the different dates were respectively: .81 tons; 1.54 tons, 2.33 tons, 3.63 tons, and 3.96 tons. At the latter date the corn was fully ripe. There was, therefore, a continuous increase in the yeilds of dry matter per acre up to the time when the corn was fully ripe. (New York Agricultural Experiment Station Report for 1889, page 87.)

In the same experiment it is shown that the yield per acre of albuminoids increases even after the ears are glazed.

In Bulletin 68, of this Station, published in 1889, it is shown that the yield of dry matter per acre increased very materially up to the time when the corn was about all glazed, when the ears were hard and the stalks nearly dry.

On the question of the changes that take place in the silo, many experiments have been performed by experiment stations in the northern United States, as is shown by the following table, which reports the results of some of these tests:

Losses of dry matter protein and N. free extract at various stations.

	Dry matter Per cent.	Protein. Per cent.	N. free extract Per cent.
Vermont Report, 1889	14.67	10.12	23.58
Vermont " 1891	20.00	13.00	-------
Vermont " 1892	18.00	11.60	26.90
Vermont " 1894	20.00	12.00	30.00
New Jersey Bul. 19	18.00	--------	-------
Pennsylvania Report, 1889	10.76	26.42	14.00
Pennsylvania " 1890	* 20.36	11.23	34.02
Wisconsin " 1889	16.54	-----------	-----------

* Average of 15 trials in Wisconsin, Pennsylvania and Missouri.

In the Wisconsin Report for 1895, page 273, this statement is made: "It thus appears, from a consideration of all the data here presented, that the necessary loss of dry matter in corn silage is considerably less than 10 per cent, and is probably as low as five to eight per cent."

In the report of the New York Station for 1892, page 162, it is shown that the loss in the silo was studied in three experiments with corn fodder and three with sorghum. The average loss for all amounted to 12.6 per cent of dry matter, 18.5 per cent of the albuminoids, and 26.6 per cent of the starch and sugar.

The losses in our experiment in 1897 were somewhat in excess of the average of these figures derived from the reports of other Stations. This is due largely, if not entirely, to the fact that our silos were smaller than those used in practical stock feeding. The surface exposed at the sides and top were relatively much larger than would be the case with larger silos, and the losses are correspondingly greater.

SPRAYING CALENDAR FOR 1898.

BY L. R. TAFT.

Bulletin 155.—Horticultural Department.

There seems to be each year an increase in the number of insects and diseases by which fruit and other plants are affected, and it is fortunate that for most of them we have at hand remedies that are effective and that can be cheaply applied. While in some cases and in certain seasons spraying is not actually a necessity, it will seldom be found that spraying to some extent cannot be done with profit. In many cases it happens that one preparation will be effectual against a number of insects or diseases, and we are often able to combine and apply at one time remedies against both insects and diseases. This greatly lessens the expense of spraying.

In order to be most effectual, the remedies against insects should be applied when they first appear, as if allowed to make their full growth they are much more difficult to kill, and in the meantime may do much harm. This is of even greater importance with fungous diseases, as they work for the most part within the soft portions of the plants, and the remedies must be used as preventives if at all. Thoroughness must also be insisted upon, as, if any portions of the plants are not properly sprayed, the insects that feed there will not be destroyed, and the spores of the various fungi will readily gain entrance.

Particularly in spraying large trees large and powerful pumps should be used. They will make it possible to reach all parts of the trees. The Vermorel, Bordeaux, McGowan and other nozzles form a fine, mist-like spray, and not only aid in the distribution of the spraying material, but do so in an economical manner.

SPRAYING CALENDAR.

For all fruits subject to the attack of fungous diseases, the application of a spray of strong copper sulphate solution (one pound in from fifteen to twenty-five gallons of water) early in the spring before the buds open, is desirable, as it will destroy the spores that have passed the winter upon the trees. This application is sometimes omitted and the first spraying is with Bordeaux mixture, after the growth has started, but before the flower buds have opened. One of the above can generally be used with profit, and both will repay the expense if fungous diseases have been troublesome the previous year. As soon as the petals have fallen from the flowers, they should again be sprayed with Bordeaux mixture to which three or four ounces of Paris green, or other arsenite, have been added for each fifty gallons. The arsenites destroy any leaf-eating insects that may appear, and should be used on the first appearance of canker-worms, slugs, tent-caterpillars and similar insects. If applied within a week after the petals have fallen, it will also aid in controlling the codlin moth and plum curculio. At the end of two or three weeks the application of Bordeaux mixture and an arsenite should be repeated, and, as occasion demands, judging from the appearance of insects and diseases, and if the conditions are favorable for the development of the latter, the trees should be sprayed. Several of our fruits are attacked by fungous diseases during the months of July and August, and, in case the fruit has been gathered, or will not ripen until fall Bordeaux mixture can be used as a fungicide, but otherwise a solution of copper sulphate, or of liver of sulphur, should be applied. For the powdery mildews fully as good results, if not better, are obtained from the use of liver of sulphur as from Bordeaux mixture, but the latter is generally preferable for other diseases as it will remain for a longer time upon the foliage.

For borers near the collar of fruit trees, the use of various alkaline washes is desirable, as they keep the bark smooth and the eggs are not likely to be deposited. The addition of Paris green, lime, sulphur and carbolic acid, is recommended by some. If the borers have entered the trunk of the trees they should be carefully dug out.

Apples and Pears.—The treatment recommended above will generally suffice for ordinary insects and diseases, but the pear is often attacked by leaf-blight, for which one or two applications of Bordeaux mixture in July and August will prove effectual. For the pear blight the injured portions should be cut off several inches below where the disease appears. The pruning knife and saw should be dipped in some disinfecting solution, such as corrosive sublimate, before it is used on other trees; this is also a good plan when pruning pear trees at any time.

Plums and Cherries.—For brown rot, shot-hole, fungus, slugs and curculio, spray with Bordeaux mixture and an arsenite. Cut out and burn "black knot". Examine the trees for it in June and again in early winter. Fungicides help to prevent its spread. For plant lice, or aphides, spray thoroughly with strong tobacco water.

Peach.—Spray with Bordeaux mixture just before the buds open, for curl leaf and brown rot. Repeat as above, adding an arsenite. When yellows appears, immediately cut out and burn the trees. Examine for borers in October and May. Dip roots of young trees in tobacco water for black peach aphis, before planting; on the roots of orchard trees apply wood ashes. Reject nursery trees with crown-gall.

Grape.—Use Bordeaux mixture and arsenites thoroughly for mildews, black rot and anthracnose, and leaf-eating insects. For mildews, particularly when the fruit is nearly ripe, use liver of sulphur, or copper sulphate solution.

Currants and Gooseberries.—For mildew, leaf spot and worms, spray with Bordeaux mixture and arsenites, when worms first appear; repeat if necessary. After second application rely on liver of sulphur for mildews. After crop is gathered use Bordeaux mixture for leaf spot.

Raspberry and Blackberry.—Dig out plants affected with Orange rust; cut out canes severely injured by anthracnose and spray with Bordeaux mixture. If the plantation becomes badly diseased start anew, using healthy plants.

Strawberry.—Spray with Bordeaux mixture and arsenites for leaf blight, leaf rollers and others insects, just before the blossoms open, and again after the fruit has set. Repeat after the fruit has been gathered.

Potato.—For the Colorado beetle spray with Paris green (one pound to one hundred gallons) and lime. For the early blight use Bordeaux mixture.

Tomato.—For the tomato worm and tomato rot, spray with Bordeaux mixture and Paris green.

Cucumbers and Squashes.—Apply plaster and Paris green for the striped beetle while dew is on. Trap black bugs under shingles, and spray with gasoline and water (one to eight), mechanically mixed. If mildews and other fungous diseases appear, spray with Bordeaux mixture and liver of sulphur.

REMEDIES.

INSECTICIDES.

For nearly all insects that eat the foliage, or other exposed portions of the trees, some material should be used that will poison them, and for this purpose the arsenites are generally resorted to. Paris green contains, when pure, rather more than fifty per cent of arsenic, and, being but slightly soluble in water, is not injurious to anything except the most tender foliage. This tendency to burn the foliage can be counteracted by the addition of a small amount of lime. The use of lime with Bordeaux mixture is of value also, from the fact that it cements the poison upon the leaves and renders its effect much more lasting. For many of the fruits, and other plants, Paris green can be combined with Bordeaux mixture to good advantage, as the two can be applied at one time, and the lime of the Bordeaux mixture will render the addition of more lime unnecessary. London purple, which is an arsenite of lime, while Paris green is an arsenite of copper, is often used instead of Paris green, but is rather less effective as an insecticide, and, being slightly more soluble, is more likely to injure the foliage. When Paris green costs more than ten cents per pound, in large quantities, white arsenic will be found a cheap and effective substitute for it. As the cost of the two materials is about the same per pound, and, as the Paris green is about one half arsenic, the latter will go twice as far, and hence be but one half as expensive.

The following formula for preparing the above insecticide can be used for all our fruits with safety, and, in case the insects have become numerous and destructive, it would be safe, except on the peach, to increase the amount of poison one half; while against the potato beetle the amount of poison can be doubled.

Paris green (or London purple)	1 pound
Lime	5 "
Water	200 gallons

Formula for white arsenic and lime mixture:

White arsenic	1 pound
Lime	10 "
Water	400 gallons

In preparing the lime and arsenic mixture, add two pounds of lime and one pound of white arsenic, to two gallons of hot water, and boil it for at least thirty minutes. This should be added to 400 gallons of water, and eight pounds of lime additional used. Care should be taken to have the lime freshly slaked. We have used this preparation for several years and find it can be used without injuring the foliage, and that it is as effective as twice the quantity of Paris green.

Sal soda is sometimes used to dissolve the arsenic, but it generally adds at least fifty per cent to the cost of the preparation and makes it nearly, if not quite, as expensive as Paris green. With a little extra labor in boiling, the mixture of lime and arsenic alone will be as effectual and fully as safe. For those who care to use the sal soda, the following formula is given:

Arsenic	1 pound
Sal soda	2 "
Water	2 gallons

Boil until the arsenic is dissolved. The above solution added to ten pounds of lime will be sufficient for 400 gallons of spraying mixture. The solution can be kept for any length of time and can be prepared for use as needed. If only fifty gallons are to be used at once, one pint of the solution and two pounds of lime only will be required.

THE ADULTERATION OF PARIS GREEN.

Many of the failures with the use of Paris green have been ascribed to its adulteration, and this will undoubtedly account for a large number of them. While it is not always infallible, any one can test Paris green by adding ammonia water to a small amount, and if pure it will all dissolve, forming a clear, blue liquid. In case, as will often happen, if adulteration has been practiced, a mass of white material remains undissolved, the amount compared with the quantity of Paris green used for the test will show the amount of the adulteration.

WHITE HELLEBORE.

Although Paris green will give as good or better results, many persons use hellebore upon currant and gooseberry bushes, cabbages, etc. The following formula will give good results:

White hellebore	1 oz.
Water	5 gallons

Care should be taken not to use this upon ripe fruit, as hellebore is a poison.

PYRETHRUM, OR BUHACH.

For use upon plants or trees any part of which is soon to be used as food, pyrethrum, or buhach, will be found an effective remedy against both biting and sucking insects. It can be applied in water at the rate of a teaspoonful to the gallon, or as a powder, either at full strength, or with from three to five times its bulk of flour or plaster. It quickly loses its strength, and to be effectual should be fresh, and should be kept in a tin box or glass bottle.

For the sucking insects, which would not be affected by the arsenites, kerosene, either alone, mixed with water, or as an emulsion, may be used.

KEROSENE EMULSION.

Kerosene	1 pt.
Soft soap	1 qt.
Water	6 qts.

Instead of the soft soap, two ounces of hard soap may be used. Heat the soft soap until it becomes liquid, or dissolve the hard soap in a quart of boiling water. Add the kerosene and agitate the mixture, using a force pump, for five minutes, or until a homogeneous, creamy mass is formed. Before using add six quarts of water. This will kill nearly all insects with soft coverings and will not injure any except the more tender plants. For the scale insects the amount of kerosene should be increased. Upon dormant woody plants it may be as strong as one part of kerosene to four of water and upon many of the trees while in leaf it can be as strong as one to six or eight.

KEROSENE AND WATER MECHANICAL MIXTURE.

Owing to the labor of preparing the emulsion various pumps have been made for the application of a spray of kerosene and water in a mechanical mixture. Among the best are those manufactured by the Deming Co., Salem, Ohio.

Not only is the labor required in making an emulsion saved, but it is even more effective as an insecticide and less likely to injure tender foliage. The proportions of kerosene and water are about the same as when emulsified, but the amount of kerosene can be increased for the scale insects. Gasoline can be used in a similar manner.

CLEAR KEROSENE.

Several parties report using kerosene with effective results and without injury to the foliage. If used at all, it should be with great care, and we caution against its use upon the peach in particular.

Just before the buds open in the spring the bark is well filled with sap, and the danger of injury then is less than at other times. If the kerosene is carefully applied so that it will not run down the trunk and saturate the soil about the roots, it can be used upon nearly all kinds of fruit trees at this time. By using a fine nozzle it can be sprayed upon the trees and will go as far as twice the quantity of other insecticides.

For trees infested with San José and other scale insects this will be a cheap and effective remedy. Care should be taken to spray upon warm, bright days, and while the trees are dry, so that the kerosene will quickly evaporate and thus lessen the danger of injury to the trees.

TOBACCO.

Many insects can be destroyed by the use of tobacco dust or smoke, but for insects on orchard trees "tobacco water" will be better. It is particularly valuable as a remedy for plant lice, although to be effectual it should be applied before the leaves have closed over the insects. The decoction can be made by soaking a half bushel of tobacco stems in a barrel of water for five or six hours. If wanted for use immediately the water should be hot. The stems can be used for several barrels of water, the color and odor of the water indicating when they have been exhausted.

POTASH LYE.

For spraying trees while dormant to destroy insects, fungi, and secure a smooth bark, use

Black potash	2	pounds
(or concentrated lye	1½	")
Water	5	gallons

Care should be taken in preparing and applying this solution as it is very caustic. It can only be used while the trees are dormant.

The addition of one pound of lime and an ounce of Paris green to the above makes it especially valuable for the trunks of trees to keep away borers.

WHALE OIL SOAP.

For all classes of insects, and particularly for those that suck the sap, whale oil soap, made from fish oil and potash, is an excellent remedy. Among the best brands are those manufactured by James Good, Hurst St., Philadelphia, who sells his Potash No. 3, at three and one half cents per pound in barrel lots, and from five to ten cents in smaller quantities. The Anchor brand of Leggett and Brother, 301 Pearl St., New York, is sold at four cents per pound by the barrel, or at six and one half cents per pound for fifty pounds. Both are reliable brands.

For scale insects it should be as strong as one or even two pounds to the gallon of water, to be applied hot while the trees are dormant. After growth starts the amount of water should be increased to five gallons to a pound of the soap. Whale oil soap may be used in making kerosene emulsion.

FUNGICIDES.

As noted above the use of the fungicides is to cover the plants and to destroy the spores of fungi which fall upon them. For this purpose Bordeaux mixture is most valuable.

BORDEAUX MIXTURE.

Copper sulphate (granulated)	4 pounds
Lime (fresh)	4 "
Water	40 gallons

The above is known as the 'one to ten' formula and may be slightly modified without destroying its efficiency. When preparing Bordeaux mixture it is advisable to first make a stock solution that can be mixed and used as desired. Take twenty-five pounds of copper sulphate and suspend it in an old basket in twenty-five gallons of water. In a few hours it will dissolve. In a box slake twenty-five or more pounds of lime. (If it will be used within a week it will be well to slake the entire barrel.) Add water only as fast as it is taken up by the lime, but take care that it does not become dry and burn. In slaking a few pounds it is well to start it with hot water. When desired for use, for forty gallons take four gallons of the copper sulphate solution, after giving it a thorough stirring; place in a barrel and dilute to twenty gallons. Then take as much of the slaked lime as would be made from four pounds when unslaked, dilute this to twenty gallons and add to the diluted solution of copper sulphate. Pour together slowly and stir rapidly while doing so, that they may form a perfect mixture. The dilution might be made after the ingredients are mixed, but it soon settles to the bottom, and does not give as satisfactory results.

When fresh (unairslaked) lime is used, and the right proportions have been added, there will be no danger of injury to the foliage, but that there may be no mistake from having too small an amount of lime, it will be well to test the mixture in some way. This can be done by adding a drop or two of ferro-cyanide of potassium, and if it changes to a reddish chocolate color it indicates that more lime is required. When no change in color is produced it indicates that the amount of lime is sufficient, but a considerable excess will do no harm. Another test is to dip a knife blade into the mixture and if on drying a film of copper is deposited the need of more lime is shown. When good lime is properly slaked there will be no sediment, but it is always well to stir up the diluted lime water and pass through a brass strainer. The lint from burlap bags, which are often used, is likely to give trouble by clogging the nozzle or pump.

COPPER SULPHATE SOLUTION.

For use upon trees while dormant, the strong solution,

Copper sulphate	1 pound
Water	15 gallons

may be used, but for use after the fruit is ripening a diluted formula,

Copper sulphate	1 pound
Water	150 to 250 gallons

should be used. The amount will vary with the kind of fruit; apples will stand the stronger solution, while on peaches one pound to 250 gallons is as much as can be safely used. To be effectual as a fungicide when the diluted formula is used, soft water should always be employed.

LIVER OF SULPHUR.

Especially for the powdery mildew upon gooseberries, grapes, etc., a solution of liver of sulphur, (sulphide of potassium) is a valuable fungicide, as, after the fruit has set, it seems even more effectual than Bordeaux mixture.

Liver of sulphur	1 ounce
Water	3 gallons

It is not poisonous and is well worthy of trial where fruits that are nearly ready for use are attacked by fungi.

INSECTS AND DISEASES AND THEIR TREATMENT.

The following brief descriptions of some of the more dangerous insects and diseases of fruit trees are given with the hope that they may aid in the detection of the presence of these pests and secure their prompt treatment. Especial attention is given to those that come under the operation of the orchard and nursery laws of Michigan, in order that the persons selected as commissioners in the different townships may have some guide that will aid them in recognizing the nature of the trouble, and in determining the proper treatment or remedy. As the remedies often fail from the fact that the nature of the insect or disease is not understood, it is urged that when any doubt exists specimens be mailed to State Experiment Station, Agricultural College, Mich. They will be examined and remedies given if possible.

SAN JOSÉ SCALE.

This most dangerous of all our fruit-tree pests has been found in a dozen or more places in the state and undoubtedly exists in still others. Every effort should be made to destroy the colonies we now have and to prevent its introduction to uninfected sections.

The insect has little power of locomotion, but may be brought in upon nursery stock, or can be carried by birds, and ants and other insects, from tree to tree. It attacks all of our fruit plants and has been found upon various kinds of forest trees.

It propagates very rapidly and three or four broods may develop in a season, so that it will quickly incrust the branches of a tree, which will then look as if plastered with coal ashes. When they first appear, they have a louse-like form and can move about, but they soon settle down, insert their slender beaks into the bark and develop scale-like coverings. During the winter the partially developed scales are black in color, nearly round, flattened; and in most cases, as can be seen with a magnifying glass, have a small nipple at the center, surrounded by a well-marked sunken ring. The size is such that a single scale to the unaided eye looks like a small black spot. The full-grown scales are of a grayish-brown and reach one sixteenth of an inch in diameter. The scales are but loosely attached to the tree and can be readily scraped off. Beneath the shell-like covering the true insect can be found. These are yellow in color and on being crushed will be found to contain a yellow oily substance.

When the scales are scattered upon the young twigs a purplish color of the bark will be noticed and on cutting into the bark it will be found much discolored. This discoloration of the inner bark is caused by no other scale, and if this is present and the ring-like depression can be made out, it indicates that it is the San José scale. This insect will ruin, if it does not kill young fruit trees, and will render large trees unfruitful, and is to be dreaded particularly on account of its rapid reproduction and small size, which render it possible for it to obtain a foothold, and even spread to adjoining trees before it is discovered, as well as because it is difficult to reach and destroy every specimen upon a tree with a spraying solution, while the cost of the materials will make it an expensive undertaking.

In case one has but a few infested trees it will be cheapest and safest to uproot and burn them, especially if they are small and incrusted with the scale.

In attempting to destroy the scale by spraying, some material must be used that has considerable penetrating power. The leading remedies are whale-oil soap and kerosene, either alone, mechanically mingled with water, or as an emulsion.

As a winter treatment use either a solution of whale-oil soap (one pound to one gallon of water), or kerosene emulsion (one part kerosene, one part soft soap, or whale-oil soap, and three parts of water). A pump should be used to make the emulsion, and the agitation should be kept up until a cream-like mass is produced. In either case the soap should be dissolved in boiling water and applied while still hot. If kerosene is to be added to form an emulsion, the soap should be removed from near the fire before adding the oil.

Before spraying the trees it will be well to cut them back severely and remove as many as possible of the small shoots; thus the surface to be sprayed will be reduced, and what remains will be near the ground. The application should be very thorough, so as to reach every part of the tree and soak all of the scales. The insects are often under bits of bark, in the crevices of the buds and even beneath the surface of the soil, and pains should be taken that none escape. This application will kill most of the scales, but, as some may survive, another application should be made shortly before the buds open in the spring. At that time the bark will be full of sap, and, if a warm bright day is selected for the spraying, it will be safe to use undiluted kerosene, (except, perhaps, upon the peach) provided it is carefully applied. Care should be taken to use a very fine mist-like spray, and to use only as much as will hold to the bark without running down the trunks. If it is allowed to saturate the ground about the roots it may be fatal to the trees.

Nearly as good results can be obtained with less danger of injury to the trees, from a mechanical mixture of kerosene and water, using three or four parts of water to one of kerosene. Special spraying apparatus is required, among the best being the kerosene sprayer made by the Deming Co., Salem, Ohio.

About the middle of June the young insects appear and a careful watch should be kept for them. If any are found the trees should be sprayed with whale-oil soap solution, or with kerosene emulsion, with eight parts of water to one of kerosene.

THE CANKER WORM.

This insect has in some seasons done much harm to apple trees, and, when its ravages have been unchecked for two or three years, it has even killed the trees. There are two kinds of canker worm, as well as other insects of similar habits; one form deposits its eggs during October and November upon the twigs of the apple trees, while the other appears during warm spells of late winter and early spring. The female moths are wingless and, as they have passed their pupal form in the ground, the only way they can reach the branches is by crawling up the trunks of the trees. Some endeavor to trap the moths, as they ascend the trees, by placing bands of paper about the trunk and smearing them with printer's ink or tar; others use various other bands and traps, but to be effectual they must be applied before the moths ascend the tree, and must be kept in a condition to act as a barrier, whenever the ground is not frozen from October to May. As this is a serious task and as, even at the best, some of the insects may evade the traps, the principal reliance is upon spraying with arsenites.

Some failures are reported, but it is probable that the spraying was delayed too long, or that it was not thorough. The eggs hatch about the time the trees blossom, and if the trees have been infested in previous years, a thorough spraying should be given just before the blossoms open, and it should be repeated as soon as the blossoms have fallen, and again if necessary. The spray should be in the form of a fine mist and should cover every leaf. To hold the arsenite upon the trees it is well to add lime to the spraying mixture. This will also aid in determining when the work has been thoroughly done, and will permit the use of a larger amount of Paris green, or other arsenite. Although it will add considerably to the cost of the mixture, from the fact that nearly all varieties are attacked upon their foliage, if not upon their fruit, by the apple scab fungus, it will generally pay to add Bordeaux mixture to the spraying material. If Bordeaux mixture is not used, a good formula will be, one pound Paris green, ten pounds of lime and one hundred and fifty gallons of water; or use one fourth of a pound of Paris green with forty gallons of Bordeaux mixture.

BLACK PEACH APHIS.

For several years the orchards in the vicinity of Grand Rapids, and in various sections along the lake shore, have been injured by what is known as the "Black Peach Aphis." This is a brownish-black, shining insect that feeds upon the roots of the trees. The individuals are so small that they can barely be seen with the naked eye, but they often appear in such large numbers on the roots that they are easily detected. These insects suck the sap from the roots, giving them a flabby appearance, and the effect upon the foliage is so marked that one familiar with their work can readily detect their presence by this alone. The leaves are generally more or less drooping, and are of a dark yellowish-green color; they are generally smaller than the leaves on healthy trees and are folded and wrinkled. Another characteristic is that numerous red spots, due to the work of fungi, appear on the leaves. Later in the season, the injured portions fall from the leaves, which appear as if perforated with a charge of shot. Trees having the appearance given above, will almost certainly be found affected with the aphis, but in a few cases the same appearance has been noticed where the trees were planted deeply, especially if they were in hard-pan or a cold, wet soil. Most, if not all, of the Michigan nurseries are free from this insect, but it may appear unexpectedly in any of them, or upon trees brought in from without the state, and, as it is so destructive, it will pay to take precautions to destroy the insects if they should be on the trees. This can be done by dipping the trees in strong tobacco water, made by soaking one half bushel of stems in a barrel of water. If, later on, it should appear upon the trees growing in the orchard, the cheapest and most effectual remedy will be the application of from one half to one bushel of unleached wood ashes about the trees. It will be more effectual if the soil is scraped back over a circle as large as the branches of the tree, and replaced after the ashes have been scattered. Tobacco stems or tobacco dust may be used in the same way and, like the ashes, will both act as an insecticide and furnish a large amount of plant food to the tree. The Black Peach Aphis is most troublesome on light sandy soils but may be found on the stiffest clays. For the most part, the insects are wingless and cannot move from tree to tree, though they are probably distributed by ants and other insects. They are found upon the roots during all of the year and in early summer they are found upon the young shoots and leaves; having been, perhaps, brought up from the soil by ants. The effect of the insect is particularly severe upon young trees, which are often, in nurseries and newly-planted orchards, killed by them. On old trees the effect is less severe and, if the trees are well cultivated and fertilized, they may be able to escape with a slight check to their growth. This insect is probably more generally distributed than is supposed, and may account for many of the failures in young trees which have been placed where old orchards have been taken out. In case it becomes desirable to replant with peaches, the land should be used for at least two years for some other crop, and an attempt should be made to increase the humus of the soil by turning under clover or other crops.

THE WOOLLY APHIS.

In several parts of the state apple trees are badly infested with the woolly aphis, which attacks the roots as well as the branches, causing knots and swellings to appear. If they are very numerous the fruit, when produced at all, will be small and imperfect and the trees will make but little growth. The root form can be treated with wood ashes or tobacco dust, and those on the branches can be destroyed with the kerosene sprays or strong tobacco water.

PEACH YELLOWS.

Yellows of the peach is placed under the jurisdiction of the yellows commissioners by the so-called, "Yellows Law," and in case trees are infected with this disease they can require the owners to destroy them within five days, or, if it is not done, they can have the trees destroyed and collect from the township the actual cost of uprooting and burning them.

Yellows may appear in trees of any age but is seldom seen until the trees come into bearing. It then shows in the premature ripening of the fruit, which takes on a very high color, anywhere from one to four weeks before its usual time to mature, and the surface is more or less covered with red spots. On cutting the fruit open, streaks will be found running from these spots to the pit, around which the color is found much deeper than in healthy fruit. In some seasons, however, certain fruits that naturally red about the pit have this color much heightened, so that these lines should not be taken as indicative of the disease. At about the time the disease appears in the fruit, indications of its presence may be seen upon the branches, where a number of small, narrow and pointed leaves may develop. When the trees are not in bearing this is the first indication that would be seen. Sometimes the disease does not appear until late in the autumn, when it manifests itself by the opening of winter buds, which normally would remain dormant until the next spring. These buds, along in November, develop short-jointed shoots, with small, yelowish-green leaves, which often remain upon the trees until mid-winter. Similar shoots often appear from the stumps of trees in which the disease has shown itself, and which have been cut down. The following year the trees will make but little growth, the leaves will be small, yellowish-green in color, and slender, branching growths will generally appear from the crotches of the branches, forming what may fruitgrowers speak of as "fungous growth." The trees become weaker each year and, at the end of two or three years from the time that they are first attacked, die from the disease. When yellows appears on, perhaps, one or two branches, many growers attempt to save the tree by cutting off the branches in which the disease has appeared, but in no case, so far as is known, have they been able to save the remainder of the tree. Even though a tree has a full crop of fruit upon it, it should be cut down and burned, on the first appearance of yellows, for, if left to ripen its fruit, the disease is likely to spread to other trees. By the prompt removal of diseased trees our growers have been able to grow peaches with but little loss from this disease, while those who failed to take prompt action have lost every tree in their orchards. This shows the importance of watching the trees carefully and applying the axe and fire when any symptoms of the disease appear. Some of our best growers make it a practice to go over their trees once a week, beginning three or four weeks before the variety will ripen, and thus are able to detect the disease upon its first appearance.

While the exact nature of the disease is not known, it is regarded as highly contagious, and no effective remedies have been found for it. It attacks all varieties and appears on all kinds of soil and in orchards under the highest cultivation as well as those in which the trees are suffering from a lack of proper food and care.

PEACH ROSETTE.

So far as known this disease has never appeared in Michigan. In Georgia and other states where it has been found, it is feared more than yellows as it kills in one year. It differs from yellows in various ways, one of which is that it has no effect on the appearance of the fruit, while in yellows the fruit is spotted, streaked, higher colored, and ripens from a few days to three or four weeks earlier than on healthy trees.

The name rosette is given from the fact that in the spring numerous slender shoots, with small, narrow, yellowish leaves, start out from the branches and, after reaching a length of from three to six inches, the buds in the axils of the leaves also develop shoots that bear still smaller leaves, and in Georgia a third series of branches may form. The leaves on these tufts are very small and may number one hundred or more and, crowded as they are, give the appearance of a rosette. There is no known cause or remedy for the disease and, as it seems highly contagious, trees that show the above described characteristics should at once be dug out and burned.

"LITTLE PEACH."

In various parts of Allegan and surrounding counties, a disease has appeared in the peach orchards, to which the above name has been given by most growers, although some call it "rosette" and others "a form of yellows." The trees have, in general, an unhealthy appearance; the new growths are short and spindling, the leaves are small, yellowish green, and inclined to roll, and, when the fruit is about an inch in diameter, its growth stops. Instead of being premature as in the case of yellows, the fruit, if it ripens at all, is much later; it shows no red spots and streaks, and seldom reaches one half its full size.

About mid-summer the trees will send out numerous shoots from the main branches. As a rule they are short, but, if the trees are young and growing in good soil, they may make a growth of several feet, forming what are commonly called "water sprouts." The bark on the growths two or three years old will be found dry and cracked; the cambium (or new ring of wood) very thin and the older wood dry and discolored beyond the normal.

After a year or two, young and vigorous trees seem to recover, but the old and especially the neglected trees gradually succumb to the disease, although they generally live for several years.

By many growers the disease is regarded as highly contagious and even more dangerous than yellows, and they recommend the prompt removal of the infected trees.

While the writer is not certain that the disease is contagious, such may be the case, and, especially if the trees are old and the wood seems to be badly injured, it will certainly be advisable from an economical standpoint, as well as safest, so far as the other trees are concerned, to immediately destroy them.

In some instances the writer has observed the disease upon young trees, and even on older ones, when the trouble seemed confined to portions along the middle of the branches, and, when cut back below the injured portions, new and healthy growths were made. Even when the branches have been but slightly shortened back, marked benefits have been secured, but it can be readily seen that the best results cannot be secured unless the injured portions have been cut away and a growth obtained from the comparatively healthy wood below. Unless the soil is fertile it should be enriched with a liberal supply of wood ashes. Stable manure would be desirable to start a new growth, and a small amount may be used to advantage, but an excess should be avoided as it will produce a soft watery growth that will be injured by the winter.

While some specific disease may be the cause of the trouble, in most cases it has every appearance of the effect of cold upon the unripe wood. In one case, young trees were growing in a corn field; after cultivation ceased the growth of the corn drew upon the moisture and plant food in the soil, causing the trees to ripen prematurely and, when the corn was cut, a second growth could readily be started by the fall rains, and this would be injured by the winter. In other cases, the wood may have been unripe in the fall, or it may have started into growth early in the spring and a few degrees of frost would in either case produce an injury to the wood similar to that found in "little peach." The cells being injured the sap would not pass through them readily, and the new growth would naturally be short, the fruit would not reach its normal size, and water sprouts would start from the branches.

In case the disease is found to be contagious it would come under the operation of the nursery law.

"GUM DISEASE" OF THE PEACH.

After rains in the early spring, patches of gum are noticed upon the twigs and smaller branches of peach trees, and examination shows the bark beneath to be ruptured. Sometimes the injury is near the buds, in which case it will generally be found that growth has started prematurely, or that it was not perfectly ripened in the fall, and has been injured by frost; the bark being ruptured the sap exudes. When away from the buds, the injury may be due to the same cause, but small spots are often found on the bark, that have been caused by fungi of various kinds, from which the sap has come. As preventives, spray the trees with fungicides, and use cover crops and mineral fertilizers, avoiding southern exposures where there is not free circulation of the air. If the branches are much injured they should be cut back below where the worst of the spots are found.

CURL LEAF.

Although not coming under the operation of the spraying and orchard inspection laws, yet the severe loss suffered last year, in all parts of the state, from this disease, makes it worthy of mention here. The effect of the disease upon the foliage of the tree is known by all peach growers. The tissues become thickened and the leaves become wrinkled and often more or less marked with yellow and red, and finally a whitish powder is seen upon the infected portions. In severe cases, all of the leaves, except those that have recently developed, drop from the branches of the trees, thus subjecting them to a severe check, and as a result some or all of the fruit drops from the tree—the amount varying with the severity of the attack. The disease is most troublesome in seasons when the weather has been wet and cold. These conditions cause a check to the development of the leaves and in that condition the spores of the fungus, which is the cause of the disease, readily gain access to the interior of the leaves. It is known that the spores and mycelium of the fungus winter upon the twigs, and if they can be destroyed the danger of the attack to the foliage will be greatly lessened. While the ordinary solution of copper sulphate, (one pound in fifteen gallons of water) is effectual in destroying these spores, better results are obtained with Bordeaux Mixture that contains a large excess of lime (five pounds of copper sulphate, ten pounds of lime and fifty gallons of water). If this is thoroughly sprayed over the trees, before the buds open, covering every portion of the trunk and branches, it will greatly lessen the danger of an attack to the foliage. As soon as the blossoms have fallen, a second application with the same mixture should be made and, if the weather is favorable to the disease, this should be repeated at the end of ten days or two weeks. Experiments for the last four years have shown that if the trees are sprayed as above recommended, there will be but little trouble from the disease. To be effectual, however, the spraying must be very thorough and must be done at the right time. Certain varieties, like Elberta, are much more injured than others, owing to the peculiarities in the growth and texture of the foliage, and when we have a variety that is little, if any, injured by the disease, it should be preferred in planting to others that are subject to the disease, providing they are of an equally valuable variety. As some of our best varieties are very subject to the disease, he should make use of the spraying mixtures who attempts to grow them.

CROWN GALL.

Many of the peach trees that have been brought into Michigan from Ohio and Maryland have shown upon their roots swellings of various sizes to which the name of "Crown Gall," has been given. These are most commonly found at or near the collar of the trees, but detached swellings have often been found upon the smaller roots. When upon large roots, or at the collar, the tree will be of little value and should never be planted, as, even if it lives, the growth will be unsatisfactory. The real nature of this trouble is not understood, but, even though it has not been definitely shown to be contagious, the trees should be regarded with suspicion. The swellings most generally appear in the nursery, and are most common when the trees have been grown in moist soil, especially if it contains a large amount of decaying organic matter. In case a tree growing in the orchard has been destroyed with crown gall, it will be safest to remove the soil and replace it with fresh materials before planting another tree. While it cannot be regarded as absolutely sure, it is possible that where there are but one or two small swellings, upon the smaller roots, the tree can be saved by cutting off the roots as far from the swellings as possible.

Care should be taken both by nurserymen and orchardists, in planting trees in wet soil, especially if the land contains a large amount of organic matter. Instances have been known where the disease was very troublesome on soils heavily enriched with stable manure, or where large amounts of saw-dust have been worked into the soil; also where raspberry plantations have been removed. Similar "galls" have been found on the apple, pear and plum, as well as on the raspberry and blackberry. Another form of gall, which appears as small nodules upon the roots, is due to the work of the "eel" worms (nematodes), but these are quite distinct both in their appearance and nature.

BLACK KNOT.

The swellings upon the branches of the plum and cherry trees, to which the name of "Black Knot" has been given, have been found very destructive. While in some seasons the growth is but slow, in others they develop rapidly and destroy entire orchards. The development of the knots begins during May and June, when, upon the branches that are one or two years old, a slight swelling will be noticed and the outer bark will crack, showing the green layer beneath, which will soon take on a russet appearance. Upon the surface an olive-green mould will soon appear, which is due to the development of summer spores of the fungus. These are borne about by the wind and serve to scatter the disease. The development of the spores continues and, by autumn, the surface will be of a black color, covered with innumerable minute pimples, in which the winter spores of the fungus will be developed. These will ripen in February and thus the disease will secure another start. The old "knots" are dry and hard and each year extend both ways along the branches, until they reach a considerable size. By carefully examining the trees during the early summer, the "knots" can be detected in the early stages of their development and, if at once cut off and burned, further spread of the disease will be stopped. In removing infected branches, the cuts should be made, if possible, a foot or more below the knots, in order that the diseased portions may be destroyed. When the knots are upon the trunks or main branches of small trees, where it would be impossible to cut them off without destroying the trees, the diseased tissues may be cut away and, if the wounds are painted with linseed oil, or tincture of iodine, the danger of stopping further growth of the tree or branch will be prevented. While the removal of diseased branches is the only remedy that can be depended on to prevent the spreading of the disease, yet, if the trees are thoroughly sprayed with Bordeaux mixture, it will be impossible for the spores to obtain lodgment upon the healthy branches. In several portions of the state, it is reported that the knots are becoming very troublesome and that they have destroyed many plum trees. In case the owners do not take prompt action to check the disease, the fruit growers of the locality have in their hands the power to see that the knots are destroyed, as it only requires a petition of ten free-holders to secure the appointment of commissioners whose duty it will be to secure the destruction of all knots and of the trees if badly affected.

PEAR BLIGHT.

The fire blight or "frozen sap blight" of the pear comes under the operation of the yellows and spraying laws. This disease is of a bacterial nature and is very troublesome in some seasons, particularly upon rapid-growing trees, or on land that has been heavily manured, or that is naturally rich in organic matter. The disease may appear upon the new growth, upon fruit spurs, or at any openings upon the branches and trunk where the bark has been cracked so as to permit the entrance of the germs. They can also enter through the flowers, or through the soft succulent tissues of the leaves or stems. The leaves upon the diseased portions turn dark brown and dry up, but remain for a considerable time upon the branches. The bark of the diseased portions also dries and becomes nearly black in color. When the disease is at work in the tissues the bark cracks and a thick sap exudes. This has a distinct taste and odor of fermentation and the disease itself is nothing more than a fermentation, brought about in the sap by the action of the bacteria. The remedy for pear blight is much the same as for "black knot," and, when any of the leaves show the characteristic appearance of the blight, the branches upon which they are should be cut off a foot or more below where any signs of the disease can be seen, and immediately burned. By the prompt removal of the diseased branches, the disease can generally be checked, while, if this is not done, it may spread until all of the surrounding trees are affected.

Agricultural College, Mich., March 10, 1898.

LEGISLATION RELATING TO INSECTS AND DISEASES OF FRUIT TREES, AND PRELIMINARY REPORT OF THE STATE INSPECTOR OF NURSERIES AND ORCHARDS.

BY L. R. TAFT AND D. W. TRINE.

Bulletin 156.—Horticultural Department.

At various times during the past sixteen years the state of Michigan has passed laws to prevent the spread of dangerous insects and diseases that have appeared in the orchards, but many fruit growers are not even aware of the existence of these laws and few, even of those in whose hands their enforcement has been placed, are informed regarding their requirements.

The first "Yellows Law" was passed in 1879 and has been several times amended until as it now stands upon the statute books (Act 109 Laws of 1895), it includes, (in addition to the yellows) peach rosette, black knot and pear blight. In 1895 the so-called "Spraying Law" was passed, but it was amended in 1897, and is now Act 2, Laws of 1897. Both laws provide for the appointment of commissioners in the townships where diseases or insects exist, and those appointed under one law have full power to enforce the other.

In 1897, another law known as the Nursery and Orchard Inspection Law was passed. This provides for the appointment of a state inspector whose duty it is to examine all nursery stock sold in the state, and such orchards as are supposed to contain dangerous insects or diseases, and take measures for their eradication.

All nurseries and tree dealers selling nursery stock in the state are required to have their stock inspected, and to take out a license and to give a bond for one thousand dollars that they will sell no stock that has not been inspected, and are, if requested, required to furnish a list of their customers for the use of the inspector. The license and bond of a nursery answers for its agents. Nurseries with headquarters in other states, which actually do business in Michigan, are also required to take out a license and give a bond, but no bond is required where they merely fill mail orders.

Nursery stock shipped into the state must be accompanied by a certificate of inspection from some authorized inspector, and, if not so accompanied, the transportation company must immediately notify the State Board of Agriculture. The law does not interfere with the delivery of the stock to the consignee. The Michigan law will be found printed in full elsewhere in this bulletin.

There is a law now before congress which prohibits transportation companies, postmasters, etc., from receiving nursery stock of any kind that is not accompanied by a certificate of inspection.

DUTIES OF OWNERS OF LAND.

Owners are required by law, in case they have peach trees diseased with yellows and rosette, to forthwith destroy the trees and fruit, and to cut off and destroy the portions of pear trees diseased with blight, and black knot upon plum and cherry trees.

When trees are infested with canker worms, San José scale and other injurious insects, or are infected with dangerous diseases, owners are required by law to effectually spray the trees, or, if necessary, to destroy them. Spraying, except for the canker worm, is prohibited while the trees are in blossom. Under the spraying law such injurious diseases and insects (aside from those mentioned above) would naturally be included, as are not commonly distributed, or which if not destroyed are likely to injure neighboring trees.

In case notice is served on the owners, by the commissioners, or by the State Inspector of Orchards or by his deputies, requiring the destruction or the spraying of the trees, (unless they avail themselves of the right to appeal as noted hereafter) they must comply with the requirements within five days or they will be subject to fine or imprisonment.

DUTIES OF TOWNSHIP OFFICERS.

When any township board or city council are aware of the presence of dangerous insects or diseases, within their jurisdiction, or when ten freeholders petition for it, it is their duty to appoint three competent freeholders as commissioners, who shall hold office during the pleasure of the board and until their successors are appointed. If the township officers neglect or refuse to make the appointment, they are subject to fine or imprisonment or both.

DUTIES OF THE COMMISSIONERS.

The commissioners shall, within ten days after appointment, file their acceptance with the city or township clerk, who shall be the clerk of the board and keep a record of their proceedings.

It is the duty of the commissioners, or any one of them, to examine any trees supposed to be infected with dangerous diseases or insects, and if the diseases or insects are found, they must put some mark upon the tree and serve notice upon the owner to destroy the tree if it is infected with yellows, or to cut off the diseased portions if it is black knot, pear blight, etc., or to effectually spray the trees in case of dangerous insects, within five days. When infected with San José scale the commissioners can, if deemed necessary, order the destruction of the trees. When the owner neglects to comply with the law within five days, it becomes the duty of the commissioners to have the trees destroyed, or effectually sprayed, as may be necessary. The commissioners are allowed for their services two dollars for each full day, and this and their other expenses must be audited by the township board or city council. Their expenses for destroying trees affected with yellows, or cutting back those with black knot or pear blight are levied upon the premises by the supervisor and collected the same as delinquent highway taxes, but for spraying or destroying trees affected with San José scale, and other injurious insects and fungous diseases, the expense must be recovered by the township from the owner of the premises in an action of assumpsit.

If the commissioners neglect their duties they are subject to the same penalties as the township board.

APPEAL.

In case the owners question the decision of a single commissioner they can appeal to the full board, and if not then satisfied they can have the matter referred to the State Inspector of Nurseries and Orchards, whose decision will be final.

For information regarding the duties of the State Inspector of Nurseries and Orchards, reference is made to Act 137, Laws of 1897, printed herewith.

PRELIMINARY REPORT OF THE STATE INSPECTOR OF NURSERIES AND ORCHARDS.

INTRODUCTION.

The Michigan legislature of 1897 passed what is known as the Nursery Inspection Law (Act 137, Laws of 1897) which required the State Board of Agriculture to appoint a state inspector of nurseries and orchards, and made it obligatory upon all nurserymen doing business in the state to have their stock inspected, and to take out a license and give a bond that they would comply with the provisions of the law. The law went into effect September 1, 1897, and the board appointed Prof. U. P. Hedrick, late of the Oregon Agricultural College, as inspector under the law. He entered upon his duties about the middle of the month, but resigned at the end of the year to accept the professorship of horticulture in the Utah Agricultural College. Mr. D. W. Trine was appointed as his successor.

Of more than one hundred nurseries inspected none were found to be infested with San José scale, although the scale was found on the premises of three tree dealers who had heeled in surplus stock. In neither of these cases was there any nursery stock growing in the vicinity that will be sold, and as all the trees that could be regarded as suspicious were at once burned, it is hoped that it has been stamped out.

As the public may be interested to know the names of the parties licensed to do business in Michigan, the list is appended. It includes all inspected and certificated by Prof. Hendrick, and the additions made by Mr. Trine up to March 25.

The law permits fruit growers to dispose of surplus plants, but all other parties who sell nursery stock in Michigan without complying with the provisions of the law are subject to fine or imprisonment, or both.

Some nurserymen have given the impression that the certificate of the inspector "guaranteed" the stock, but it does nothing of the kind, as it merely states that he has examined the stock and has found no trace of injurious insects or dangerous diseases. It in no way guarantees the stock to be true to name or even well grown, and should not be understood as applying to the quality of the stock except as above stated.

The report of Prof. Hendrick and the full text of the law is herewith given.

LETTER OF TRANSMITTAL.

HON. FRANKLIN WELLS, *President State Board of Agriculture:*

DEAR SIR—As State inspector of orchards and nurseries under the direction of your honorable board, I herewith transmit to you a list of the nurserymen and dealers in nursery stock, who have applied for inspection and license, under the provisions of Act 137, Laws of 1897, to sell nursery stock in Michigan. I respectfully recommend that the list of those who have secured license, together with the laws of the State pertaining to the pests of orchards, be published, and sent to the fruit growers of the State.

The inspection of the seventy-five nurseries in this State, and the clerical work pertaining to the work of granting certificates of inspection and securing bonds from these and the thirty-two dealers in Michigan and the twenty nuserymen and dealers in other states, whose names are on the lists, I hand you, have occupied all of my time during the three months I have had charge of the work of orchard and nursery inspection.

Very respectfully,

U. P. HEDRICK.

AGRICULTURAL COLLEGE, MICH.,
December 31, 1897.

SAN JOSE SCALE AND NURSERY INSPECTION LAW.

AN ACT to prevent the introduction and spread of San José scale or other injurious insects or infectious diseases of trees, vines, shrubs or plants grown in this State or imported from other states, provinces or countries.

[Act 137, Laws 1897.]

Board of Agriculture to appoint inspector of nurseries and orchards.

Term of office. duties.

SECTION 1. *The People of the State of Michigan enact,* That it shall be the duty of the State Board of Agriculture, immediately upon the taking effect of this act, to appoint some competent person who shall be known as State inspector of nurseries and orchards, who shall hold office during the pleasure of said board, whose duty shall be to inspect any and all nurseries in the State of Michigan, as to whether they are infested by San José scale or other injurious or destructive insects or infected with infectious or contagious diseases, and if upon such inspection he find no such dangerous insects or diseases, he shall upon payment of per diem fee hereinafter provided, give to the owner of such nurseries a certificate to that effect, and shall file a duplicate certificate with the State Board of Agriculture; and in case he shall find present in any such nursery any of said dangerous insects or diseases, he shall notify the owner thereof in writing, and shall direct him within five days to use such means as will exterminate such dangerous diseases or insects, and the owner of such nursery shall not ship nor deliver any such trees, vines, shrubs or plants affected by such dangerous insects or diseases until he shall have secured from said inspector a certificate as aforesaid.

Owner of nurseries, etc., to destroy insects or diseases in trees.

Not to ship nor deliver trees infected.

SEC. 2. The owner of such nursery, trees, vines, shrubs or plants shall, within the time specified in such notice, take such steps for the destruction of such insects or diseases as will exterminate the same, and shall not ship nor deliver any such trees, vines, shrubs nor plants affected with such dangerous diseases or insects under the penalty of a fine of one dollar for every tree, vine, plant or shrub so affected, when shipped or delivered from such nursery, which fine shall be collected by suit by the prosecuting attorney of the county in which said nursery is located.

In case owner refuse to destroy infected trees, duty of inspector.

SEC. 3. Whenever it shall happen that the State inspector of nurseries and orchards shall give the notice heretofore required to the owner of a nursery, for the destruction of the insects or diseases mentioned, and said owner shall fail or neglect to take the measures necessary for the destruction thereof, within the time mentioned in the notice given him, it shall be the duty of the State inspector of nurseries and orchards to have the proper remedies applied to such nursery for the destruction of such diseases or insects, and shall employ all necessary assistance and may enter the premises of said owner of such nursery for the purpose of treating and exterminating such insects or diseases, and the said owner of such nursery shall be liable for the costs of such proceeding, for the services of the inspector at a rate per diem to be fixed by the State Board of Agriculture, not to exceed three dollars per day, and for such number of days as said board shall determine, which said charge must be paid before delivery of the certificate in section one of this act.

May employ assistance.

Owner liable for costs.

Amount.

Name of consignor to be on package when shipped from out of State.

SEC. 4. Whenever any trees, shrubs, plants or vines are shipped into this State from another state, country or province, every package thereof shall be plainly labeled on the outside with the name of the consignor, the name of the consignee, the contents, and a certificate showing that the contents have been inspected by a State or government officer, and that the trees, vines, shrubs or plants therein contained appear free from all injurious insects or diseases. Whenever any trees, shrubs, vines or plants are shipped into this State without such certificate plainly fixed on the outside of the package, box or car containing the same, the fact must be reported within twenty-four hours to the State Board of Agriculture by the railway, express or steamboat company, or other person or persons carrying the same; and any agent of any railway, steamboat or express company, or any other person or persons who shall violate the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than twenty-five nor more than one hundred dollars, or imprisoned in the county jail not less than five nor more than thirty days, or may be so fined and imprisoned in the discretion of the court, and any such fine shall be paid to the State Board of Agriculture.

Government inspector to inspect shipments.

Violation a misdemeanor.

Penalty.

When owners of nurseries to apply for inspection of stock and license to sell.

SEC. 5. Any person or persons growing or offering for sale in this State any trees, vines, shrubs or plants commonly known as nursery stock, shall, on or before the first day of August in each year, apply to the State Board of Agriculture, for inspection of said stock under the provisions of this act and a license for its sale, and shall deposit with said board a fee of five dollars as a license fee for himself as principal.

License fee.

License to be good for one year.

Bond.

To file list of purchasers with Board of Agriculture.

Penalty for not filing list.

Proviso as to who may sell or exchange trees.

Such license shall be good for one year and shall not be transferable, and each of such persons, principals, shall execute to the State Board of Agriculture, a bond, in the sum of one thousand dollars, with good and sufficient sureties satisfactory to said board, conditioned that he will comply with all the provisions of this act, and that upon demand he will file with the State Board of Agriculture, a list of the persons to whom he has sold or delivered any such nursery stock, giving the species, together with the postoffice address of each purchaser, which list shall be held in strict confidence by the said State Board of Agriculture, and not be subject to inspection by the public. Failure on the part of any nurseryman, grower, agent or dealer to comply with the provisions of this section shall render him or them liable to the penalties of a fine of not more than one hundred nor less than twenty-five dollars, or imprisonment in the county jail for not more than ninety nor less than thirty days, or both such fine and imprisonment in the discretion of the court, for each and every such sale. Such information shall be preserved and be for the sole use of the nursery and orchard inspector and his deputies: *Provided*, That the provisions of the preceding sections shall not apply to persons engaged in fruit growing, who are not nurserymen, who desire to sell or exchange surplus trees or plants of their own growing.

Foreign firms or corporations to obtain license from board to sell in this State.

To file bond and certificate with board.

SEC. 6. No person, firm or corporation resident of another state, province or country shall engage or continue in the business of importing any trees, plants, shrubs or vines, commonly known as nursery stock, into this State, or of selling such importations within the State, or of selling such articles within the State, for subsequent importation into it, without first having obtained from the State Board of Agriculture a license to do business in this State as provided in section five of this act, and shall have filed with the State Board of Agriculture the bond therein required, together with a certificate of inspection by a state or government inspector or that of some person designated by the Michigan State Board of Agriculture for such purpose.

Upon receipt of fee board to issue license.

SEC. 7. The State Board of Agriculture shall, upon receipt of the fee referred to in this act, together with the required bond and a satisfactory certificate of inspection, issue licenses to the applicant according to the provisions of this act.

In case of dispute between commissioner and owner as to infected trees, inspector to investigate.

To recommend proper remedies, decision to be final.

SEC. 8. Whenever the commissioners under acts number one hundred and eight and one hundred and nine, session laws of eighteen hundred and ninety-five, known as yellows commissioners, shall be uncertain as to the existence or nature of any infectious or contagious disease or dangerous insect pest in an orchard or elsewhere, or in case any dispute shall arise between owners and commissioners, it shall be the duty of said commissioners to notify the State inspector of orchards and nurseries, who shall at once investigate or inquire into the matter and suggest or recommend the proper remedies, and give all the information he can to aid in exterminating such insects or diseases, and his decision of the case and recommendation shall be final.

When may enter premises and inspect orchards.

SEC. 9. It shall be the duty of the State inspector, whenever it shall come to his knowledge that any destructive insects or infectious or contagious diseases exist in any orchard in this State, or are supposed to exist, to investigate the case, and if such dangerous insects or diseases are found, he shall have authority to enter upon the premises and proceed according to the provisions of sections one, two and three of this act, in exterminating the same. In case the owner or occupant of the premises shall refuse or neglect to comply with the orders of said inspector within five days, the inspector shall employ such aid as may be necessary to carry out his orders and recommendations, the expense of which procedure shall be certified to the township board and by them allowed, who shall cause the same to be assessed as a special tax upon the premises concerned.

In case owner refuse, how to proceed.

May appoint deputies.

SEC. 10. The State inspector of orchards and nurseries shall have power to appoint such number of deputy inspectors as may be required, subject to approval by the State Board of Agriculture.

Expenses, how audited and paid.

SEC. 11. All expenses incurred under the provisions of this act, not otherwise provided for, shall be audited by the State Board of Agriculture, and paid out of the general fund of the State, and the Auditor General shall draw his warrant for the same: *Provided*, That all moneys collected by the State Board of Agriculture, under this act, shall be paid into the general fund of the State treasury.

Proviso as to moneys collected.

NURSERYMEN.

[The following is a list of nurserymen and dealers who have taken license up to March 25, 1898. The licenses expire August 1, 1898. I. H. BUTTERFIELD, Secretary State Board Agriculture.]

Archer, Thos. & Co., Lake Shore Nurseries, St. Joseph, Mich.
Allen Nursery Co., Rochester, N. Y.
Bowman, Thos. W. & Son, The Rochester Star Nurseries, Rochester, N. Y.
Brooke, F. W., Ithaca, Mich.
Bragg, L. G. & Co., Kalamazoo, Mich.
Babcock, W. C., Bridgman, Mich.
Bigelow, J. N., Bangor, Mich.
Bogue, Nelson, Batavia Nurseries, Batavia, N. Y.
Baldwin, O. A. E., Bridgman, Mich.
Brown Bros. Nursery Co., Continental Nurseries, Rochester, N. Y.
Buttrick & Watterson, Pomona Nurseries, Cascade, Mich.
Bryant Bros., Dansville, N. Y.
Carroll, W. J., Otsego, Mich.
Chesebro, F. H., South Haven, Mich.
Central Michigan Nursery Co. (Stock Co.), Kalamazoo, Mich.
Chase, W. D., & Co., Geneva, N. Y.
Chautauqua Nursery Co., Geneva, N. Y.
Cole, W. B., Painesville, O.
Curtis, L. T. & Sons, Genesee Co. Nurseries, Flint, Mich.
Chase Bros. Co., New England Nurseries, Rochester, N. Y.
Dean, Geo. N., Shelbyville, Mich.
*Dressel Bros., Hart, Mich.
Dunham, Enos W., Grand Mere Plant Farm, Stevensville, Mich.
Ellwanger & Barry, Mount Hope Nurseries, Rochester, N. Y.
Empire State Nursery Co., Waterloo, N. Y.
Flemer & Felmly, Springfield, N. J.
Flansburgh, C. N., Leslie, Mich.
Foote, Oscar C., Ogden, Mich.
Ford, Frank & Son, Ravenna, Ohio.
Green, A. W. & Son, Green's Fruit Farm, Michigan Center, Mich.
Gray, J. S., Bangor, Mich.
Gustin, C. F., Adrian, Mich.
Grand Rapids Nursery Co., Grand Rapids, Mich.
Greening Bros., River Raisin Valley Nurseries, Monroe, Mich.
Hawks Nursery Co., Rochester, N. Y.
Hugueny, Hack & Co, Monroe, Mich.
Herman, Henry A., Floral City Nurseries, Monroe, Mich.
Higgins, Geo. D., Otsego, Mich.
Headley, J., Ada, Mich.
Herbst, Wm. G., Maybee, Mich.
Havekast, G. H., Monroe, Mich.

Husted, N. P. & Co., Lowell Nurseries, Lowell, Mich.
Hoppin, A. D., Bangor, Mich.
Hawley, E. & Sons, Oceana Nurseries, Hart, Mich.
Hamilton, A., Peach Belt Nurseries, Bangor, Mich.
Ilgenfritz, E. C. & Co., Monroe, Mich.
Ilgenfritz, I. E. Sons, Monroe Nurseries, Monroe, Mich.
Jaquay, Irving & Co., Benton Harbor Nurseries, Benton Harbor, Mich.
Joy & Scofield, Bloomingdale, Mich.
Jeffrey, James, Gull Prairie, Road Nurseries, Kalamazoo, Mich.
Kalle, Peter, South Haven, Mich.
Kellogg, R. M., Three Rivers, Mich.
Lewis, A. E., McCords, Mich.
Luetchford, R. D. & Co., Rochester, N. Y.
Lampson & Rood, Covert, Mich.
Marsh, S. K., Sheridan, Mich.
*Mason, A. W. & Co., Palo, Mich.
McVean, F. D., Montieth, Mich.
Maile, Geo., South Haven, Mich.
Maudlin, E, Bridgman, Mich.
Moody, E. & Sons, Lockport, N. Y.
Michigan Nursery Co., Monroe, Mich.
Nelson & Son, J. A., Paw Paw, Mich.
Nash, C. C., Three Rivers, Mich.
Northern Orchard and Nursery Co., Augusta, Mich.
Peirson Bros., Waterloo, N. Y.
Picket, G. S., Clyde, O.
Patty, D. H., Geneva, N. Y.
Prater, G. E. Jr., Wolverine Nurseries, Paw Paw, Mich.
Pearson, D. S. & Co., William Street Nursery, Geneva, N. Y., Grand Rapids, Mich.
Rakestraw & Pyle, Willowdale, Pa.
Reynolds Bros., Lowell, Mich.
Rupert, W. P. & Sons, Seneca, N. Y.
Stone, Jno. & Son, Hillsdale, Mich.
Stickney, E. R., Otsego, Mich.
Stahelin, R. J., Bridgman, Mich.
Spielman Bros., Adrian, Mich.
Sinclair, Mrs. E. S., McCords, Mich.
Sheldon & Son, P. B., Albion, Mich.
Sweet, G. A., Nursery Co., Dansville, N. Y.
Souter, Geo. H., Holland, Mich.
Sears, Henry & Co., Geneva, N. Y.
Stuart, C. W. & Co., Newark, N. Y.
Van Dusen Co., The C. L., Geneva, N. Y.
Wooll, I. A., Elsie, Mich.
Wood & Fortney, Vicksburg Nursery Co., Vicksburg, Mich.
Wise, Ralph, Otsego, Mich.
Weston, A. R. & Co., Bridgman, Mich.
Whitney, G. W., Nursery Co., Dansville, N. Y.
Whitten, C. E., C. E. Whitten's Nursery, Bridgman, Mich.
West Michigan Nurseries (Stock Company), Benton Harbor, Mich.
Wright, F. L., Plainfield, Mich.

DEALERS.

Augustine, L. D., St. Joseph, Mich.
Allmand, F. H., Ann Arbor, Mich.
Bailey, H. A., Jackson, Mich.
Boyd, J. B., Central Lake, Mich.
Chase Co., The R. G., Geneva, N. Y.
Clark & Bertsch, Holland, Mich.
Dean, H. R., Grand Rapids, Mich.
Dow, H. C., Bravo, Mich.
Davis, S. B., Jackson, Mich.
DuBois, Theodore, Saginaw, Mich.
Essig, W. W., Detroit, Mich., Geneva, N. Y.
Fox, John & Son, Woodland, Mich.
Freeland, F. M., Sherwood, Mich.
Haight, G. W., Shelby, Mich.
Horton, Daniel D., Greenville, Mich.
Hills, Wilson, Davison, Mich.
Lewis, Geo. H., Monroe, Mich.
Ludwig, W. E., Lake Odessa, Mich.
Major, William H., Centreville, Mich.
Marlatt, S. P., Jackson, Mich.
Maynard & Coon, Maynard & Coon Nursery & Seed Co., Grand Rapids. Mich.
Nale, D. C., Pontiac, Mich.
Perkins, H. D., Grand Rapids, Mich.
Pruyn, Jno., Grand Rapids, Mich.
Pilkinton, S. H., Portland, Mich.
Rees, Wm. E., Mt. Clemens, Mich.
Schumacher, H. C., Sparta, Mich.
Stone, J. B., Vermontville, Mich.
Smith, Milton H., Morocco, Mich.
Taplin, S., Detroit, Mich.
Tatro, Louis N., Sawyer, Mich.
Tyler & McEachran, Muskegon, Mich.
*Wrisley, M. J., Grand Rapids, Mich.
Wright, M., Grand Rapids, Mich.

HOG CHOLERA.

BY GEO. A. WATERMAN, CONSULTING VETERINARIAN.

Bulletin 157.—Veterinary Department.

Inasmuch as a large number of letters have been received asking for information concerning hog cholera, and also by reason of the fact that the disease is becoming quite prevalent throughout the State, it has been thought best that a bulletin be published upon the subject. The bulletin is a compilation of material from various sources and not from original work done by the writer. The reports from the Department of Agriculture at Washington, D. C., also bulletins from the Experiment Stations of Indiana, Iowa, Arkansas, Nebraska and other states, have been consulted.

Hog cholera, a disease peculiar to swine, has existed in this country to a greater or less extent for the past fifty years. It may appear at any time of year, although perhaps it is most often met with in autumn. There is another disease called swine plague which very closely resembles hog cholera in its effects and without doubt is often mistaken for it. At other times it is found associated with hog cholera, both diseases existing in the same herd, or even in the same animal. Inasmuch, however, as the results of the two diseases are about the same it is of little practical importance, whether we differentiate between them or not. Hog cholera attacks animals of all ages, but at times older hogs seem to be able to withstand the disease better than pigs.

CAUSE.

The cause of hog cholera is the introduction into the body, through some avenue, of the specific germ of the disease, which is known as the hog cholera bacillus. For a short description of germs in general, what they are, and what they do, I would refer the reader to Bulletin No. 139. The virus in this disease gains entrance into the body through the digestive tract with the food or water, or it may enter through the lungs with the air. Fresh wounds may also at times furnish an opportunity for its entrance. Inasmuch as the theory of spontaneous generation of bacteria, as well as of other forms of life, has been exploded it is evident that in order to have an attack of hog cholera the virus of the disease must be introduced into the herd in some manner. A study of some of the ways by which the virus is carried from place to place will better enable us to understand how to prevent the disease.

The air is a medium by which the germs of most diseases pass from place to place and so it is in hog cholera and the spread of the disease in this way is hard to hold in check. Streams furnish a means of conveying the virus from place to place. The water of an entire stream is often polluted by hog cholera in some herd which has access to it. Ponds, especially if fed from streams from other farms, are a source of contagion. Dogs and other small animals, that roam at will, may carry in the dirt upon their feet the virus, if it so happens that they pass through a yard or field where an affected herd is kept, or if they find the carcass of an animal which died from the disease and has carelessly been left lying where they can get at it. Crows and other carrion birds may also be the means of conveying the disease in the same way. Buyers going from drove to drove, or visitors, may spread the disease. The introduction of new stock into the herd is always fraught with more or less danger, especially if they have been shipped on the railroad. All new stock should be quarantined upon another part of the farm for five or six weeks before placing them in the herd. Railroads spread the disease by carrying infected animals. For this reason fields bordering upon railroads may be looked upon with suspicion for the pasturing of hogs.

The time elapsing after the animals are exposed, or the germs are introduced into the herd, before the disease manifests itself, varies from four or five days, to three or four weeks.

SYMPTOMS.

The symptoms of hog cholera are somewhat variable. In some cases it takes a very acute form, the animals living only a day or so; while at other times it may run a lingering course of three or four weeks. In some outbreaks quite a large per cent of the cases will recover; while at other times nearly every animal affected will succumb. At times those that recover will do well, growing and fattening nicely, and again they will seem to be stunted and never amount to much.

Generally the first symptom noticed is that the animal refuses his feed to a greater or less degree. There is apparent weakness of the hind limbs, arching of the back and a drawing up of the abdomen; shivering is also noticeable. The animal manifests a desire to bury himself in the litter, or if there are a number they will huddle together. Oftentimes red spots or blotches will appear on the surface of the skin, especially on the abdomen, ears and inside of the legs. There is more or less fever, indicated by a rise of temperature, the normal temperature of the hog being about 102°. At times more or less coughing is present; this symptom being more noticeable in swine plague than in hog cholera. There is a discharge from the eyes, at first watery, later becoming thicker and tending to cause the eyelids to adhere to each other. At the beginning of the disease the bowels may be normal, or they may be constipated; but as the disease advances there is apt to be an offensive diarrhœa. At times nearly all of these symptoms will be present, and then again only a part of them will be recognizable. Frequently either few symptoms are present, or they are so uncertain, as to require a microscopic examination of the tissues to diagnose with certainty.

The post mortem conditions are also somewhat variable. There are apt to be red spots on the internal organs much like those upon the skin. If swine plague is present the lungs are liable to be inflamed; greater or less portions of them being dark colored, resembling somewhat a portion of the liver. The spleen is often found to be two or three times its normal size. In those cases where the disease has been somewhat prolonged quite a characteristic symptom is the presence of ulcers upon the inner surface of the intestinal wall, especially of the large intestine where the small intestine opens into it. These ulcers appear as slightly elevated, yellowish or darkish colored sores.

TREATMENT.

The medicinal treatment for hog cholera has not proven satisfactory, neither is it probable that it ever will. At times a certain line of treatment will promise great results when used in one herd, but utterly fail when used in others. The explanation for this is, that in those cases where the medicine seemed to be beneficial the disease took a milder course and a large percentage would probably have recovered without any treatment. The Department of Agriculture at Washington, D. C., has recommended a formula which will probably be found to be as beneficial as anything. It is as follows:

Sulphur	1 pound
Wood charcoal	1 pound
Sodium chloride	2 pounds
Sodium bicarbonate	2 pounds
Sodium hyposulphite	2 pounds
Sodium sulphate	1 pound
Antimony sulphide	1 pound

These substances should be thoroughly mixed; the dose is a large tablespoonful to each 200 pound hog, once a day. If the animal does not eat, add the medicine to a little water, shake thoroughly and give from a bottle by the mouth. If the animal will eat, mix the medicine with sloppy food. The same drugs are recommended as a preventive by giving them along with the feed to those animals that do not as yet show signs of disease. Five to ten drops of carbolic acid given twice a day to each medium sized hog may also be found to be beneficial. Hyposulphite of soda in two drachm doses has been recommended, this however is incorporated in the above prescription. Remember, the writer does not claim marked curative or preventive properties for the foregoing medicines; but simply says they are probably as good as any, which is really saying but very little indeed.

Aside from the medicinal preventive treatment there are precautions well worthy of our consideration. We have discussed to some extent the various ways by which the germs causing the disease, may be introduced into the herd. Preventive measures then would be to endeavor to close up the avenues by which the germs may gain admittance. A few suggestions along this line may not be out of place.

Never introduce new hogs into the herd until they have first been quarantined for five or six weeks. Care should also be taken in taking females away for service.

Do not allow hogs to have access to streams or stagnant ponds; supply water from wells.

If cholera is anywhere within a number of miles, divide the herd into smaller droves and keep these separated from each other as far as possible. Confine the animals to comparatively small yards with good feeding and nesting places. Keep the surroundings clean. The sprinkling or air-slaked lime about the pens, or the use of a five per cent solution of crude carbolic acid every few days will be found beneficial. Feed a mixed diet and keep the animals as vigorous and thrifty as possible. A powder composed of sulphate of iron ½ pound, bicarbonate of soda ½ pound, nux vomica ¼ pound and arsenic 1 drachm, thoroughly mixed, giving to each four or five medium-sized hogs a tablespoonful once a day, will help to produce thrift and vigor.

If an animal manifests symptoms of disease remove the healthy ones at once to new quarters, having first removed all dirt from them by the liberal use of water. In the majority of cases it will probably be as well to destroy the diseased animal at once, and burn the carcass and thus try to hold in check the further spread of the disease. If thought best, however, to treat, give dry, comfortable quarters, sloppy diet and the drugs that have already been suggested.

TO DISPOSE OF THE DEAD.

Great care should be taken to see that the carcasses of the dead are disposed of properly. It is better to burn the carcass along with the litter and all that is of little value that has been used around the sick. If not burned, bury deeply in some place where hogs will not be allowed to run for a year or so, and before covering the carcass with dirt cover it with air-slaked lime. In moving the carcass from where the animal died to where it is to be burned, or buried, guard against spreading the germs along on the ground by placing the carcass in a box; afterwards burn the box.

TO CLEAN THE PENS WHERE ANIMALS HAVE DIED.

If the pens are the small, portable, inexpensive kind, burn them or discontinue their use for one or two years. If a larger structure, burn all the litter and inexpensive parts, wash the inside thoroughly with a five per cent solution of crude carbolic acid, or with a solution of corrosive sublimate one part, to one thousand parts of water, i. e.,one ounce of corrosive sublimate to eight gallons of water. This is probably better than the carbolic acid solution but as it is a deadly poison, caution is necessary in using it. Either of these solutions may be applied with a broom or with a spray pump. After thus thoroughly disinfecting the pen, white-wash it, using boiling water to make the white-wash and apply it while hot. If the pigs have had access to small yards scrape the surface dirt and litter into a pile and burn them, sprinkle the ground liberally, first with chloride of lime and after a few days with air-slaked lime. Treat the fences about the yards the same as the pens. Use the chloride of lime and air-slaked lime on the floor of the pens the same as in the yards. Do not introduce new animals into the same quarters for at least six months. Better if the pens can remain vacant through one winter. It would be an additional safe-guard to repeat the disinfecting once or twice in the meantime.

If the building to be disinfected is comparatively tight sulphur fumes can be used to advantage. To fumigate in this way take tin pails, fill half full of dirt and place them in tubs half filled with water; put the sulphur in the pails and pour over it a little alcohol and when all is ready light the alcohol. Use five or six pounds of sulphur to each thousand cubic feet of space. Keep the building closed for twenty-four hours or longer. Too much care cannot be exercised in cleaning and disinfecting pens where hogs affected with hog cholera have been kept.

If the sick hogs have been allowed to roam in a field where disinfection is impossible no other hogs should be allowed in the same field for a year or two.

In the foregoing discussion the serum treatment, which is promising to be of much value in the cure and prevention of hog cholera, has not been taken into consideration. Inasmuch as it is a promising remedy it may be well to explain what it is, and how it is used. The serum or antitoxin treatment has been somewhat recently introduced into medicine for those diseases which are produced by bacteria. It has been used during the past two or three years with a marked degree of success in cases of diphtheria. In diseases which are produced by germs it is not the germs, but rather a poison which the germs produce in the process of life, which causes the disturbance in the body. When germs are introduced into the body, they commence to multiply and in the multiplication and growth produce their peculiar poison; the poisons differing in the different species. As soon as this poison commences to be formed, the body in order to protect itself commences to produce a counteracting substance which is called antitoxin. The struggle for existence has begun. Sometimes the body is victorious, enough of the antitoxin being produced to counteract the action of the poison; the germs are worn out and the body recovers its normal condition. At other times the fight is a losing one for the body, the poison being produced in such quantities as to cause death. In some diseases the body is nearly always victorious, while in others it is nearly always defeated. The relative number and strength of the germs, and the vigor of the body will decide the contest. A strong animal is always better able to withstand disease than is one whose constitution has been weakened, either by poor care and feeding, or by improper breeding.

The principle of the antitoxin treatment then, is to introduce into the diseased animal some antitoxin, which has been produced by artificial methods in some other animal. The animal selected for this work is generally the horse, but cattle are sometimes used. Great care is necessary to see that the animal thus used is free from all disease.

The germs causing the disease, the treatment for which the antitoxin is to be used, are grown artificially in some beef tea. A very small amount of this beef tea culture is then injected beneath the skin of the horse, or animal used for the production of the antitoxin. This will cause a slight attack of the disease and in order to combat it the body produces the antitoxin. In a short time the slight fever produced subsides and the animal returns to health. A larger amount of the beef tea culture is then injected, producing similar results. This process is continued, injecting larger doses each time, until very large amounts of the culture can be injected without causing serious disturbance. The animal is then said to be immune, the system being charged with antitoxin. A little blood is then drawn from the animal and tested and if it contains a sufficient amount of antitoxin the animal is bled, some six to eight quarts of blood being withdrawn. This blood is set in a cool place and allowed to clot when the serum, or liquid portion, separates from the solid portion. The serum is then prepared for use by filtering and sterilizing. It takes from three to four months to render the horse immune, so that the serum contains sufficient antitoxin for use. The same animal may be utilized again for the production of more serum by repeating the process.

In the case of hog cholera the serum is used in the treatment, and also in the prevention of the disease by injecting a small amount of it beneath the skin of the animal to be treated. One dose should be sufficient. Whether the antitoxin introduced with the serum directly counteracts the poison produced by the germs, or whether it also stimulates the body to the production of more antitoxin is a disputed question.

In the report of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, to the Secretary of Agriculture, he says: "I have the honor to state concerning the experiments made during the past summer for the control of hog cholera that the treatment with antitoxin serum gave better results than were expected from it, and that this method constitutes a satisfactory plan for treating the disease and preventing by far the greater part of the loss." Dr. Salmon also recommends that Congress be asked to appropriate sufficient funds that the Bureau may produce large quantities of antitoxin serum to be distributed throughout the various states, that its value may be more thoroughly demonstrated.

Park, Davis & Co., of Detroit, also other private firms will no doubt be prepared to furnish the serum in the course of a few months.

It is to be hoped that the treatment will prove to be all that it has promised. Even if it should, the same sanitary precautions should be carried out to prevent the spread of the disease, for antitoxin cannot be expected to act beneficially except under favorable circumstances.

AGRICULTURAL COLLEGE, MICH.,
April 1, 1898.

SOME EXPERIMENTS WITH POULTRY.

BY CLINTON D. SMITH AND C. S BROOKS

Bulletin 158.—Farm Department.

SUMMARY.

The hen house being located on a dry, preferably sandy, knoll, and facing the south, the windows should be exclusively upon the south side and of good size. Where the floor area of the chicken house was 19.5 by 11.5 feet, a window 6 feet wide by 5 feet and 8 inches high did not cause severe freezing in the pens except on the very coldest days of winter and afforded an abundance of sunshine. A window one foot narrower is recommended.

Where the incubator is placed in a room whose temperature is reasonably even and is properly managed a high per cent of hatch may be expected only (a) when the hens have plenty of exercise, (b) when the eggs are fresh laid.

In an experiment involving the feeding of 86 chickens it was found that finely ground grain was slightly better than coarsely cracked and that corn was somewhat better than wheat, later when the chickens were approaching maturity. A second experiment shows that where the chickens weighed nearly five pounds apiece it cost very much more to put on a pound of gain than when they were younger.

Young ducks gain much more rapidly than chickens of the same age and put on their gains more economically. They sell better than chickens and, at the present market prices, bring in a greater profit.

Where three pens of thirty-five hens each, matched as to breed, relation to the laying period and in all other known respects are fed alike for six months the number of eggs laid by the pens were 2228, 2362, 2288, a difference large enough to be significant had the conditions been varied in any one respect.

A pen, each of twenty pullets and five yearling hens, of the Brown Leghorn, Barred Plymouth Rock and Golden Wyandotte breeds respectively was fed for a year and the number of eggs counted and weighed. The Wyandottes laid in the year 3555 eggs weighing 451.8 pounds, the Leghorns laid 3225 eggs, weighing 322.5 pounds, and the Plymouth Rocks 3360, weighing 419.2 pounds. The hens were fed alike and consumed approximately the same quantity of food. The extract from the College record shows a marked difference of breeds in the number of eggs laid.

The eggs laid by different breeds have approximately the same composition, nor do extreme changes in the character of the foods supplied cause marked variations in the composition of the eggs. The latter contain about seventy-five parts water, and twenty-five parts solids. The solids are made up of albumen, fat and ash, 12 per cent of the white and yolk being albumen, 10 per cent fat, and about 1 per cent ash.

The feeding of capons during the winter was found to be profitable, since they made goods gains at a comparatively low food cost.

I.—THE POULTRY HOUSE.

Whether the main object in keeping poultry be production of eggs or fattening growing fowls the success of the enterprise depends in no slight degree upon the location and arrangement of the house and yard. In the first place the lands upon which the establishment is placed must be dry, elevated, and well drained. All breeds of chickens thrive better on sand or sandy loams than on clay, and the larger breeds, feathered as some of them are to the feet and even to the end of the toe, cannot endure confinement to damp localities. In the next place the ground should slope to the south or southeast. Nature's great germ destroyer is the sunlight. Provision should be made therefore to give free access to the sunlight to every inch of floor space in the hen house. The hen yard should be as far as possible on the south side of the house and should slope away to the south or southeast. The windows must, of course, be on the south side and on the south side alone, so that the earliest beams of the morning sun may enter and the house be light, airy and dry. The health of the flock depends on dryness, warmth, and plenty of sunlight.

The poultry houses should be so placed as to allow for large runs. On the ordinary farm it is necessary to keep the chickens confined for some portion of the year, to prevent injury to the garden or growing field crops. Large runs should therefore be provided that the fowls may be induced to take that abundant exercise which experience shows to be essential to prolificacy.

Finally the convenience of the owner is worthy of some consideration. During certain seasons, the poultry house must be visited not once but many times every day and a great loss of time and work will be avoided if it is conveniently located with reference to the other buildings on the farm. It should not abut upon the garden nor should it be connected under the same roof, with the horse stalls, sheep sheds, or cattle barns. It would better be a distinct feature of the farm equipment separate from all other buildings. Fumigation can then be given when necessary without interfering with the other buildings and the ubiquitous hen lice will not cause discomfort to the farm stock.

In the construction of the hen houses at the College these general principles were regarded. It was necessary to provide accommodation for a large number of breeds to be used in giving instruction to the students as to varietal differences. The first hen house was therefore so planned as to allow for the housing of a large number of breeds and a smaller number of hens than would be recommended for commercial purposes. The horizontal dimensions of the building were forty feet long east and west by twenty-four feet north and south. An alleyway three feet and six inches wide extends east and west through the center of the building, with eight narrow pens on either side. A window hung on hinges at the top is provided for each pen. Necessarily the windows on the north side of the alley face the north. This is a very unfortunate feature of the building for winter management. These northern windows become coated with frost and even with a thick layer of ice which makes the air of the whole house damp and chilly. Flight holes are also provided, protected by suitable swinging boards which can be opened and closed at will.

The internal arrangement of the pens is such as to allow a complete view of the interior of each from the alleyway and farther for the removal of the eggs without entering the pens. The nest boxes are placed against the partition with holes cut into the alley through which the eggs are removed. These nest boxes have a slooping cover upon which rest the removable roosts. These roosts are made of two by fours, rounded on top and held together by cross boards. Nothing in the pens is fastened to the walls. Whenever it is desired to clean and disinfect the house all of the fixtures may be removed to be cleaned and whitewashed outside of the building. The inside of the pens are thus left free of obstructions and ready for thorough disinfection.

The floor is concrete. Three inches of coarse gravel mixed with cement, in the proportions of seven of the former to one of the latter, were first laid down. The gravel and cement were mixed dry then moistened only, thoroughly mixed and very firmly packed in place. This was the foundation for the floor. For the top dressing, the floor itself, a mixture of two parts sharp sand and one of Portland cement, mixed to a thin mortar was spread on evenly and the surface troweled smooth. One barrel of Portland cement will lay seventy square feet of floor.

Such a hen house while useful as quarters for a few individuals of a large number of breeds, is not well adapted to the use of either the general farmer of the poultryman. When, therefore, in the spring of 1895, by reason of changes in other buildings, it became possible to build another, one was constructed having in view the wants of the practical farmer. The entire house is forty-six feet long by nineteen and one-half feet wide, inside measurements. It is divided by cross partitions into four equal and similar pens, one of which may be described, since it shows how cheaply and simply an efficient poultry house may be built. The long slope of the roof is towards the north. The south side, instead of being vertical, is thrown back twenty-five degrees in order that the window may be approximately at right angles to the rays of the sun at noon during the cold months of winter.

The floor of the house is made of gravel mixed with enough fine earth to pack solid. Such a floor is not only cheaper than cement or lumber, but it is in many respects better. It is drier, furnishes dust baths for the fowls and all things considered healthier.

The frame work consists entirely of two by fours. On the north side the height of the eaves is but four feet. The roof is flat, the pitch not exceeding one quarter. Seven feet and eight inches above the floor horizontal studding were put across from the top of the windows on the south side to the rafters and the ceiling was nailed to these studding. The greatest heighth of the room is therefore seven feet and eight inches and from this runs down to three feet and one half on the north side. Everything in the pen is removable.

The window in the west pen, Pen 1, was six feet and three inches wide by five feet and eight inches high, containing 35.41 square feet. In the next pen east, Pen 2, the window was but five feet and three inches wide and contained therefore 29.75 square feet. For Pen 3 the window was but four feet and three inches wide, having an area of but 24.08 square feet. Fairly good ventilation was secured by wooden boxes, six inches square extending from the ceiling to a foot and one half above the roof. These ventilators were provided with slides, that the amount of air escaping could be regulated.

Maximum and minimum thermometers were placed in each pen and their readings noted daily at the same hour through the winter. In the following table there is given the maximum and minimum temperature and the difference for the day in each week showing the greatest variation. The figures given are degrees Fah.

	Pen 1.			Pen 2.			Pen 3.		
	Max.	Min.	Var.	Max.	Min.	Var.	Max.	Min.	Var.
January 13	48.5	35.	13.5	48.	36.	12.	49.5	36.	13.5
" 16	58.5	28.	30.5	52.	33.5	18.5	53.	32.	21.
" 28	61.5	38.	23 5	60.5	40.	20.5	57.	36	21.
" 30	64.	36.	28.	62.	41.	21.	56.5	40.5	16.
February 11	50 5	28.5	22.	55.	33.	22.	57.	32.	25.
" 16	52 5	28.	24.5	52.	32.	20	58.	30.	28.
" 20	47.5	24.	23 5	51 5	29.5	22.	55.	30.5	24.5
March 1	51.	29.	22.	46.	32.	14.	43.	38.	5.
" 5	53.	33.	20.	49.	41.	8.	54.	33.	21.
" 14	56.	28	28.	52.	46.	6.	59.	34.	25.

The results are inconclusive but it is interesting to note, that in Pen 3, the thermometer rarely fell more than two degrees below freezing while in the pen with the largest window, Pen 1, it fell on several occasions to 22 degrees and often to 28 degrees. On the coldest days of winter, February 16th and 17th, the minimum thermometer in Pen 1, stood at 22, in Pen 2, at 24.5 and in Pen 3, at 27. The sun shone brightly during the day with a brisk south west wind. The mercury out doors fell to —22° during the night and rose no higher than —10° during the day on the 16th and 12 above during the day on the 17th. The maximum thermometer in the pens showed the following readings: Pen 1, 54; Pen 2, 54.5; Pen 3, 58.

On the 19th of February a cloudy day with a southwest wind, following a very cold night in which the thermometer dropped to 4 below, the maximum thermometer in Pen 1, rose to but 37½ degrees during the day while the lowest reading of the minimum thermometer during the night was 22. A study of the temperatures in the pens during the winter seemed to indicate that for the cold and cloudy weather of winter the windows in Pen 1, were slightly too large. On the other hand on clear days the abundance of warm sunshine was heartily enjoyed by the hens. There were no cases of roup among the fowls in any of the pens nor did any of them suffer with colds indicating any bad effects of extreme variation of temperature.

INCUBATORS.

The management of an incubator is theoretically a simple matter. All that seems necessary to secure the hatching of a very high per cent of the eggs is that they shall be fertile and fresh, and that they shall be kept at a uniform temperature, between 100 and 103 degrees Fahrenheit, for twenty-one days, and that the moisture conditions be properly regulated during the latter stages of the hatching process. As a matter of practical experience, however, it is found that to secure these seemingly simple conditions is not an easy matter. It requires skill, patience and considerable experience to operate the best of incubators satisfactorily. The experiments conducted at this Station have not so far resulted in establishing new principles or bringing forward new methods. None of the forms of incubators here tried can be trusted to self regulation for a single day. The per cent of hatch is measured largely by the amount of careful and constant attention given the incubator. This attention must be directed to the following points among others:

1. The incubator must be placed in a room where the temperature is reasonably even. If the variation in temperature in the incubator room varies more than a few degrees it is impossible to so regulate the delicate apparatus, in the incubators that the temperature in the egg chamber will be constant. The maximum allowable variation for the different machines has not been definitely determined.

2. Laying aside, as out of the sphere of this bulletin, all rules as to the adjustment and management of the incubator itself, it was found necessary to a good hatch that the eggs from hens having plenty of exercise be selected. Not only must attention be paid to the breed and strain of blood of the laying hens and to their health, but they must be given a wide range and a superabundance of exercise. In one case, for instance, an incubator received 200 eggs, all from healthy stock. Seventy-five eggs were laid by a flock of thirty hens, kept in a hen house nineteen and a half feet by eleven and one-half and allowed in addition the run of a lot twenty-three rods long by three rods wide. The hens were fed a great variety of feeds consisting for the most part of a warm mash in the morning and coarse, unground grains in the evening with plenty of green stuff, cabbage, lettuce, grass and the like and regular feeds of cut bone and oyster shells.

The remaining 130 eggs came from the flock of a neighbor whose hens were allowed the utmost freedom, were in fact never confined at all but roamed where they pleased over farm, garden and barns. They picked up most of their feed but received daily a small allowance of grain. Of the 75 eggs from the carefully housed hens, 27, or 36 per cent hatched; of the 130 eggs from hens allowed to run where they pleased, 95, or 73 per cent hatched. There were in all 140 fertile eggs.

3. Repeated trials have shown that eggs freshly laid hatch better than where there has been delay in incubating. This fact partly accounts for the failures often experienced when eggs are shipped considerable distances and a week or more elapses before the incubator is ready for them.

For the first twenty-four hours after the chickens are removed from the incubator the young things require no food. For the next week we have found nothing better than the yolks of hard boiled eggs, cracker crumbs, oat flakes and some properly prepared green food like lettuce chopped fine. Only as much feed is given as is eaten up clean but the feeding is repeated at least four times per day. An abundance of sharp grit in the form of a coarse sand is always provided. Everything about the brooder is kept scrupulously clean, especially in warm weather. Fermenting foods are fatal to fowls. For this reason we have been somewhat chary in the use of skim milk. In many cases when it has been added to the ration diarrhoea has followed which could, as far as our observations went, be ascribed to no other cause. For the first week, therefore, we have given pure water alone rather than both water and skim milk, which of course would be fed separately.

COARSELY CRACKED VS. FINELY GROUND GRAIN FOR YOUNG CHICKENS.

Eighty-six Barred Plymouth Rock and fourteen Golden Wyandotte chickens were selected from a lot hatched in an incubator May 12, 1896. The Barred Plymouth Rocks were from eggs purchased of a farmer living near the College, the Golden Wyandottes from eggs from the College poultry yard. These chickens were placed in a brooder and fed largely on cracker crumbs and the yolks of hard boiled eggs for the first ten days. On the 22nd of May the chickens were divided into two pens of fifty each, forty-three Barred Rocks and seven Wyandottes. On that date Pen 1 weighed 5.7 and Pen 2, 5.8 pounds. The chickens were housed in an outdoor double Superior brooder whose rated capacity was 120 chickens. The brooder was placed in the center of a yard fifteen feet square which was also divided into two equal parts by a central fence. For the latter part of May and early June artificial heat was applied for the entire twenty-four hours, later during the night only. The chickens were allowed to run out except on rainy or chilly days.

The grain ration of both pens consisted of corn and wheat mixed in equal proportions. Pen 1, had the grain in the form of coarsely cracked corn mixed with an equal weight of clean wheat screenings free from dirt and weed seeds and containing the small kernels only, the fine meal was sifted from the cracked corn. Pen 2, had the corn ground into a fine meal and mixed with the wheat ground into a coarse flour. Both pens had the grain mixed with sweet skim milk for the morning and noon feed. The quantity of skim milk used was alike in both pens, and just sufficient to thoroughly moisten the meal without making it sloppy. The two pens received equal quantities of oyster shells, finely cut green bone, lettuce and cabbage. While the chickens were small the grass in the yard furnished sufficient vegetable matter; on the 5th of June they began to receive lettuce at the rate of a pound and one-half per day per pen. To this was added cabbage on the 26th of June. The feeding period continued seven weeks. In this time each pen ate 11.5 pounds of finely crushed oyster shells, 14 pounds of cut green bone, 55.5 pounds of lettuce, and 48 pounds of cabbage. Pen 1, ate 39.25 pounds of wheat screenings and the same quantity of corn. Pen 2, ate a pound more of each.

In the seven weeks, seven chickens in Pen 1, and six in Pen 2, died.

At the close of this feeding period, on the 12th of July, the forty-three chickens in Pen 1, weighed 49.8 and the forty-four in Pen 2, 59.5 pounds.

So far in the experiment there was a difference of 9.6 pounds in gain on the side of the fine ground grain. Out of this should be taken the weight of one chicken or 1.3 pounds, leaving the net superiority in the gain 8.3 pounds. There were five more pullets in Pen. 1, than in Pen 2.

Taking all these facts into consideration it seems safe to draw the conclusion that with an abundant supply of green bone and vegetables there is a slight advantage on the side of grinding the grain food of young chickens fairly fine and giving it to them at least twice a day in the form of a damp and crumbling but not sloppy mush.

II. Wheat against cracked corn. From the 12th of July to the 23rd of August the same two pens of chickens were used to compare whole wheat with cracked corn for growing chickens. The two pens at that time were alike in thriftiness, the oyster shells, green bone and vegetable feeds were continued. The number of chickens in Pen 1, was 43 and in Pen 2, 44. Pen 1, received whole wheat and Pen 2, coarsely cracked corn. Each pen received in the six weeks 37.5 pounds of lettuce, 162 pounds of cabbage and 48 pounds of rhubarb, besides 10.75 pounds of oyster shell and 14.5 pounds of green bone. Pen 1, consumed 145.25 pounds of wheat and Pen 2, 159.5 pounds of cracked corn.

On the 23rd of August Pen 1, weighed 101.5 pounds, making a gain of 51.7 pounds in the six weeks. Pen 2. weighed 117 pounds making a gain of 57.5 pounds.

Disregarding the other feeding stuffs consumed the chickens ate, per pound of gain, 2.8 pounds of wheat in Pen 1, and 2.77 pounds of corn in Pen 2.

These results being altogether inconclusive the feeding was kept up for six weeks longer or until October 5th. In this additional time each pen had eaten 10.75 pounds of oyster shells, 18 pounds of green bone, 102 pounds of cabbage, 42 pounds of turnip tops, besides their grain ration. Pen 1, ate 190 pounds of wheat and Pen 2, 207.5 pounds of corn. Pen 1, gained 72.5 pounds and Pen 2, 83 pounds. Again disregarding the other parts of the ration we find that it required to produce a pound of gain 2.62 pounds of wheat in Pen 1, and 2.5 pounds of corn in Pen 2.

There seems to be no great difference, therefore, in the feeding value of these two cereals when so large a bulk of the ration is made up of other materials. The gains made were satisfactory and again point to the advantage, if not the necessity, of variety in the ration of growing fowls. These chickens had to be limited in their range to small yards in order that we might know just what they ate. The grit was supplied to them in the form of the oyster shells and gravel. The ground bone supplied them with a good deal of nitrogenous matter as well as acting as a grit. The vegetable food was absolutely necessary to properly regulate the bowels and to keep the chickens thrifty and healthy. With all of these factors supplied in abundance, corn and wheat seem to be about equal for the grain ration, a slight advantage resting on the side of the corn.

For the three weeks following October 5th the pens were fed alike. The experiment was continued to see whether it would take more feed to put on a pound of gain as the chickens grew heavier. In the three weeks each pen had 2 pounds of oyster shell, 12 pounds of green bone, 30 pounds of sunflower seeds and 42 pounds of turnip tops. Pen 1, had in addition 82 pounds of corn and 61 pounds of wheat; Pen 2, had 76 pounds of corn and 62 pounds of wheat. Pen 1 weighed October 26, 195.8 pounds, having made a gain of 21.8 pounds in the three weeks. Pen 2, on the same date, weighed 223.5 pounds showing a gain of 23.5 pounds in the 21 days. Again disregarding the other factors of the ration we cannot fail to note that in this period wherein the chickens approached the average weight of five pounds it required 6.56 pounds of grain to make a pound of gain with Pen 1, and 5.8 pounds in Pen 2. These figures are significant and go far to show that one of the most common mistakes in poultry fattening is holding the chickens too long in the fall.

RELATIVE GAINS OF YOUNG DUCKS AND CHICKENS.

On the sixth of June thirty-nine young ducks, two weeks old, were weighed and placed in a brooder, and yard attached, to be fed against the same number of chickens of the same age placed in another brooder and yard. On that date the 39 ducks weighed 13.25 pounds and the 39 chickens, 7.5 pounds.

The feed of the ducks consisted of middlings, corn meal and bran, besides the necessary grit and green food. The green food consisted of lettuce and the run at a grass patch included within the fences of the small yard. The young things were very fond of this grass and ate it almost continuously which will account for the small amount of grain food required for their growth.

The chickens were fed relatively more corn meal than the ducks and had no middlings. They were also allowed the run of a small grass plat and were fed lettuce in addition. Both pens had abundant exercise and were healthy and thrifty. The experiment was continued but five weeks as by that time the ducks were nearly ready for the early market.

In the five weeks the ducks ate 41.3 pounds of corn, 93.1 pounds of middlings, 43.4 pounds of bran, and 59 pounds of lettuce, besides 88 pounds of skim milk. In the same time the 39 chickens, ate 52.2 pounds of corn, 25.9 pounds of bran, and 46 pounds of lettuce besides 44.3 pounds of skim milk. No estimate can be made of the amount of grass eaten by the two pens.

On July 11th the ducks weighed 122 pounds, having gained 108.75 pounds in the five weeks and this notwithstanding the fact that one of the ducklings died on the 18th of June in the second week of the test. The average weight of the ducks on July 11th was therefore 4.36 pounds.

The thirty-nine chickens weighed, July 11th, 30 pounds, having gained but 22.5 pounds in the five weeks and averaging when seven weeks old but three-quarters of a pound.

In estimating the cost of the gain the values of the different materials was calculated as follows: The corn, at $14.00 per ton, the bran the same, the middlings at $15.00, the milk at twenty cents per hundred, and the lettuce at one cent per pound. At these rates the total cost of the 108.75 pounds of gain of the ducks was $2.06 or 1.9 cents per pound. This is of course the food cost alone. The food cost of the gain of the chickens was $1.09 or 4.84 cents per pound. The ducklings gained therefore not only much more rapidly than the chickens but more economically as well.

Although not bearing directly on the experiment, it may be reported that twenty-nine of these ducks were sold at eight and a half cents per pound, July 21. They weighed at that time 112 pounds.

At that date the broiler season being over, the chickens were not large enough to sell at any price. The feeding of the 39 chickens was kept up until August 8. At that time they weighed 65.5 pounds and had eaten in all 137.7 pounds of corn, 39.9 pounds of bran, 128 pounds of skim milk, and 88 pounds of lettuce. At the prices already given the total cost of the gain from July 11th, was $1.27, or three and one-half cents per pound. The chickens were worth in the market nine and one-half cents per pound. The sixty-five and a half pounds brought, therefore, $6.22.

FEEDING LAYING HENS.

Three pens of laying hens were fed in the adjacent divisions of the hen house described on page 331 to indicate the differences to be expected in the number of eggs produced by fair sized flocks of hens identical in age, breeding and feeding. Each pen contained four Minorcas, four White Plymouth Rocks, nine Barred Plymouth Rocks, five Light Brahmas, all full bloods, and eight grade Plymouth Rocks and five cross bred Buff Wyandotte-Light Brahmas. As these fowls had been hatched at the College it was possible to match the pens evenly as to age and relation to the laying period as well as to the breeding of the fowls.

The hens were kept in the hen house nights and during stormy days. The hens in each pen were allowed the run of a large lot twenty-three rods long by three rods wide.

The feeding of the pens was practically identical. They were given a mixed diet containing as great a variety of foods as possible. The grain ration was a mixture of corn, oats, bran, wheat and oilmeal. With this ration was fed boiled potatoes, cut bone, and cabbage. Some middlings were fed after the first of May. A light breakfast of corn meal, ground oats and bran, wet with enough water to make a dry mush and mixed with boiled potatoes and occasionally a little oil meal was given at daylight. Some loose grain was then scattered in the bedding, to induce the hens to exercise. A weighed head of cabbage was hung from the ceiling or nailed to the side of the pen at such a heighth from the floor as to compel the hens to exert themselves to reach it. In the afternoon more grain was scattered as in the morning and the hens were compelled to scratch for their supper.

The experiment began January 1, 1896, and continued to July 1st. During the month of January the pens were kept separate and were fed alike. For that month the number of hens in each pen was but thirty. On the first of February five hens were added to each pen making the number in each breed as above stated. The next table gives the amount of food consumed by each pen from the first of January to the first of July:

	Pen 1.	Pen 2.	Pen 3.
	Lbs.	Lbs.	Lbs.
Cornmeal	191.2	191.6	191.6
Ground oats	81.7	81.6	81.3
Bran	125.0	144.4	144.4
Middlings	52.6	52.6	52.6
Boiled potatoes	179.2	193.0	194.0
Oilmeal	24.0	28.1	23.4
Ground bone	76.5	75.5	73.5
Cabbage	101.0	94.0	94.0
Wheat	298.0	291.0	297.0
Oats	115.6	104.6	104.4
Corn	179.4	179.4	196.0

The next table gives the weights of the hens at the dates mentioned:

	Pen 1.	Pen 2.	Pen 3.
	Lbs.	Lbs.	Lbs.
January 1	120.0	120.0	121.0
February 1	138.5	140.0	150.5
July 1	193.0	203.0	206.0
Gain February 1 to July 1	54.5	63.0	55.6

In the interval while Pen 2 lost none of its inmates, Pen 1 lost two hens and Pen 3, one. The average weight of the chickens in Pen 1 was, at the close of the experiment, 5.85 pounds, in Pen 2, 5.8 pounds and in Pen 3, 6 pounds. It is manifest therefore that when the numbers in the pens are considered the relative gain was not different in the three pens.

Turning now to the number of eggs laid which is the gist of the experiment, the results are given by months in the following table:

	Pen 1.	Pen 2.	Pen 3.
January	97	83	140
February	276	141	196
March	438	570	530
April	398	697	541
May	546	473	471
June	473	398	410
	2,228	2,362	2,288

Pen 2 gained in the six months eight and one-half pounds more than Pen 1, and in the same time laid 134 more eggs. Although the pens were made up alike in breed, age and relation to the laying period this variation occurs. While this difference is not large, had a change in condition, whether of feeding or some other item involved in the care, been made between these pens, the difference would have been large enough to be considered somewhat significant. The fact that it occurred when all known conditions were alike teaches again the danger of drawing conclusions from the results of one experiment.

A COMPARISON OF THREE BREEDS OF HENS AS TO THE NUMBER AND WEIGHT OF EGGS LAID IN A YEAR AND THE FOOD COST.

On the first of January, 1897, 20 pullets and five yearling hens of each of the three breeds tested were weighed for the experiment. The breeds to be compared were the Golden Wyandotte, the Single Comb Brown Leghorn, and Barred Plymouth Rock. Since the fowls were pure bloods and the eggs were therefore needed for hatching purposes two roosters were put in each pen at the beginning and removed June 18th. The health of the hens in the different pens was in general good. Still where the fowls had to be confined as in this case the death of some of the inmates of the pens was inevitable. During the first six months of the test one hen in each pen died. During the second six months the Golden Wyandottes and Plymouth Rocks each lost one hen and the Leghorns two. The weights of the pens are given in the next table.

	No.	Weight.	Average weight.
Pen 1—Golden Wyandottes:			
January, 1897	25	134 25	5 37
July, 1897	24	133.00	5.54
January, 1898	23	184.00	8.00
Pen 2—Brown Leghorns:			
January, 1897	25	97.00	3.88
July, 1897	24	89.00	3.71
January, 1898	22	110.00	5.00
Pen 3—Plymouth Rocks:			
January, 1897	25	153.25	6.12
July, 1897	24	144.50	6 02
January, 1898	23	195 00	8.49

The average gain per hen by the Wyandottes was 2.63 pounds for the year, that of the Plymouth Rocks 2.37, and for the small Leghorns, 1.29 pounds.

During the cold weather of winter each pen was confined to a department of the chicken house already described. When the weather was suitable they were given outdoor exercise, each pen being allowed the run of a large lot, partly sown to rye which afforded a supply of green food for the summer months. Sunflower seed was planted in each plot to afford shelter from the blazing sun of midsummer. The time of the experiment covered the entire year and is for the purposes of this report divided into two periods of six months each.

The feed consumed by the several pens was practically the same except the grain, and was as follows:

	Pen 1.	Pen 2.	Pen 3.
	Lbs.	Lbs.	Lbs.
For the first six months:			
Cornmeal	87.4	87.4	87.4
Ground oats	139.7	134.5	134.5
Middlings	52.3	52.3	52.3
Bran	90.5	90.5	90.5
Table scraps	319.0	319.0	319.0
Cabbage	24.0	24.0	24.0
Mangolds	49.0	49.0	44.0
Ground bone	24.5	24.5	27.0
Corn	82.0	70.0	79.6
Oats	48.8	36 6	45.0
Wheat	181.0	160.8	181.0
Oyster shells	56 0	80.0	54.0
Pratt's Poultry Food	5.7	5.7	5.7
For the second six months:			
Cornmeal	92.0	92.0	92.0
Ground oats	107.5	110.0	110.0
Bran	15 5	15.5	15.5
Table scraps	201.0	208 0	206.0
Cabbage	154.0	154.0	154.0
Corn	110.5	110.0	110 0
Oats	10.0	9.5	9.5
Wheat	185 0	185.0	184.0
Oyster shells	24.0	28.0	26 0

The number and weight of eggs by months is recorded in the next table.

	Pen 1.		Pen 2.		Pen 3.	
	No.	Weight.	No.	Weight	No.	Weight.
		Lbs.		Lbs.		Lbs.
January	279	34.6	205	23.2	202	25.5
February	368	45.9	230	25.4	302	37.2
March	472	58.4	424	51.0	491	62.9
April	472	59.3	458	54.5	465	58.4
May	504	62.4	454	53.2	428	53.0
June	379	57.4	407	47.6	326	41.0
Total for six months	2,474	318.0	2,178	251.9	2,214	278.0
July	327	42.9	412	50.8	336	41.5
August	293	36.8	318	38.2	333	42.2
September	190	22.9	191	21.1	240	29.9
October	123	14.2	92	9.7	120	13.6
November	72	8.1	13	1.3	27	2.7
December	76	8.9	21	2.2	90	11.3
Total for six months	1,081	133.8	1,047	123.3	1,146	141.2
Total for year	3,555	451.8	3,225	322.5	3,360	419.2
Weight of one dozen eggs	....	1.525	....	1.20	....	1.496

To aid in correctly interpreting these results a few facts are recorded in the history of each pen. Pen 1: one hen died Feb. 16th and another August 31. Two hens were sick April 15th but recovered by the close of that month, they were troubled with sore eyes and stopped laying. On April 23rd two hens were broody but began to lay again by the 8th of May. The dates when other hens in this pen wanted to sit were as follows, two on May 31st; one, June 12th; two June 23rd; two June 27th; two July 16th; one July 19th; six July 25th; one July 28th.

In Pen 2: one hen died May 2nd. Fewer hens in this pen showed inclination to sit than in the other. The dates when they showed this disposition were as follows: one, May 10th; one, June 5th; one, June 12th; one, June 24th; two, June 27th; one, July 17th; one, July 26th; two, August 22nd. After July 1st two hens died in this pen, one August 3rd, and the other August 22nd.

Pen 3: In this pen the first hen died April 12th, and the second August 3rd. There was no evidence of a desire to sit by the hens in this pen until April 11th, when three remained on the nest. On April 16th there were two more; April 23rd, three others; May 14th, another; May 23rd, another; May 31st, June 1st, each two; June 5th, three; June 7th, two; June 24th, three; June 27th, two; July 16th, five; July 20th, three; July 25th, three; August 25th, two; September 5th, one; September 21st, two.

The method of treating these hens that wanted to sit was to shut them away from the nests for periods ranging from two to six days when the incubating desire left them.

As far as number of eggs laid in the year as a whole is concerned the pen of Golden Wyandottes takes the lead with 3555 to its credit. The Barred Plymouth Rocks come next with 3360 and the Brown Leghorns last with 3225. The same relative position is retained when the weight of the eggs is considered. The weight of a Wyandotte egg is 27 per cent more than that of a Brown Leghorn egg. The time is sure to come when eggs will be sold by the pound instead of by the dozen. A dozen eggs weighing but 1.2 pounds is not worth as much as one weighing 1.5. And the consumer should not be charged the same for them. The markets are already discriminating against the small eggs and the difference will become more marked in the future.

Bearing on the same point, the relative egg laying qualities of the different breeds of fowls, there is given below an extract from our egg record for the first six months of 1897. A small flock of from four to six yearling hens of each of the breeds mentioned below was kept in a breeding pen in the College hen house. The egg record of each pen up to the first of July is here given:

	No. of hens.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
S. C. B. Leghorns	5	44	54	89	68	87	61	403
R. C. B. Leghorns	5	47	36	75	96	95	73	422
White Plymouth Rocks	6	28	56	88	123	76	76	447
Cornish Indian Games	4	44	42	51	43	40	33	253
Dark Brahmas	5	--------	49	87	67	41	52	296
Golden Wyandottes	5	56	73	96	108	112	69	514
Partridge Cochins	4	61	64	65	68	51	61	370
Barred Plymouth Rocks	6	80	76	69	75	77	78	455
S. P. Hamburgs	4	34	59	49	75	62	68	347

The average number of eggs per hen was, for the Single Comb Brown Leghorns 80.6; for the Rose Comb Brown Leghorns, 84.4; for the White Plymouth Rocks, 74.5; for the Barred Rocks, 75.8; for the Golden Wyandottes, 102.8; for the Silver Penciled Hamburgs, 86.7; for the Partridge Cochins, 92.5; for the Dark Brahmas 59.2; and for the Cornish Indian Games, 63.2.

The hens in these pens had been purchased to illustrate to classes of students the forms and plumage demanded by the American standard of perfection. They were for the most part prize winners or at least high scoring birds at the various poultry shows held in the State either in the winter of 1896 or 1897. While, therefore, each pen was a fair representation of the breed as far as appearance was concerned it could not be supposed to fairly represent the breed in laying qualities. In poultry, as in other kinds of live stock, it is easy to magnify too greatly the importance of breed. Wheeler, at the New York Experiment Station, has demonstrated the possibility of developing laying strains and meat producing strains of a single breed that shall differ from each other fully as much as distinct breeds would be expected to do. It is more than probable, therefore, that in the production of the specimens of the different breeds represented in the College flock, since the attention was directed solely to securing birds of the right form and plumage to meet the requirements of the standard, the egg laying qualities were neglected and lessened.

The farmer, whether he makes poultry his specialty or keeps hens as an adjunct to other farm operations, will pay attention first to the ability of his hens to produce eggs of good size and in profitable numbers. He may, in addition, without injuring the egg laying abilities, select his breeding fowls with some eye to form and plumage, making these things of course a subordinate factor. In making selections of his fowls he will be guided along breed lines, as the first consideration. If he is so situated as to be able to produce economically and sell at a profit chickens for meat he will naturally select some of the larger breeds. If eggs alone are his object he will select some breed belonging to the American section of fowls as distinguished on the one hand from the heavier Asiatics, including the Cochins and Brahmas and on the other the Mediterranean including Leghorns, Hamburgs and Minorcas. The medium sized fowls representing the American class are, among others, the Wyandottes, and Plymouth Rocks. It cannot fail to be noted that in the records reported above this class of fowls exceeds the Leghorns in the number and weight of eggs laid during the year.

CHEMICAL COMPOSITION OF EGGS.

Mr. T. A. Chittenden, a member of the graduating class, made some analyses of eggs in the preparation of his graduating thesis. The work was done under the close supervision of the chemical department of the Experiment Station. Two phases of the possible variations in the composition of eggs were studied. First the question whether the eggs laid by one breed differed in composition from those laid by another where all the fowls were fed alike, and secondly whether extreme changes in the diet would produce variations in the composition of the eggs laid by fowls of the same breed.

The ration for the hens used in the study of the variation in composition due to the variation in breed was composed of a dry and crumbling mush in the morning and dry grain feed in the afternoon. The mush was made of a mixture of corn meal, oat meal, bran, and table scraps wet with milk to which was added crushed oyster shell. In the afternoon the hens were given corn, oats and wheat with green food, mostly lettuce and cabbage.

In the chemical analysis of the eggs the shells were rejected and determinations made of the water, fat, albumen, ash and total solids in the mixed yolks and whites. The carbo-hydrates were not determined. Mr. Chittenden reports the results of the analyses as follows:

Breed.	Water.	Fat.	Albumen.	Ash.	Solids.
	Per cent	Per cent.	Per cent.	Per cent.	Per cent
Brown Leghorn	74.82	9.66	12.39	1.02	25.18
Barred Plymouth Rock	74.42	9.20	11.63	.95	25.58
Buff Cochins	73.52	10.15	12.88	1.00	26.48
S. Grey Dorkins	75.34	9.40	12.29	.96	24.66
White Wyandottes	74.44	9.85	11.81	.97	25.56
Partridge Cochins	74.16	10.20	11.97	.94	25.84

The variation in the composition of the eggs laid by different breeds is too slight to be of practical importance.

To study the question of the influence of the character of the ration on the composition of eggs one pen of Barred Plymouth Rocks, Wyandotte and Brown Leghorn hens were fed a ration consisting of one pound of meat scraps, eight pounds of wheat, and one pound of oil meal, with oyster shells and lettuce in abundance. A second pen of the same breeds was fed a ration of seven pounds of corn, one pound of tallow, two pounds of rice meal with lettuce and oyster shells. The experiment began February 1, and continued to March 9th. Owing to the comparatively close confinement neither pen was very prolific. The eggs of the different breeds were analyzed separately. In the pen fed nitrogenous food the eggs laid by the Leghorns and Plymouth Rocks March 8, and by the Wyandottes February 28, were analyzed. Of the carbonaceous pen the eggs laid by the Plymouth Rocks March 4, by the Leghorns March 8, and by the Wyandottes February 25, were analyzed. The results follow:

Composition of eggs, hens fed meat scraps, wheat, etc.

Breed.	Water.	Fat.	Albumen.	Ash.	Solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Plymouth Rocks	74 50	8.64	12 71	.89	25.50
Wyandottes	75.81	9.49	12.44	.92	24.19
Leghorns	74 72	10 36	12.96	.87	25.28

Composition of eggs, hens fed corn, tallow, rice meal, etc.

Breed.	Water.	Fat.	Albumen.	Ash.	Solids.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Plymouth Rocks	73 69	11.15	12.87	.98	26 31
Wyandottes	75.23	10.51	11.85	.94	24 77
Leghorns	75.72	9.78	12.74	.97	24.29

There is an apparent difference of almost one per cent of fat between the average of the meat fed and the corn fed fowls. The feeding period was so short that these results are not conclusive, but are reported as the findings of a preliminary experiment.

WINTER FEEDING OF CAPONS.

On the first day of September fifty capons were set aside for this test. These chickens were hatched in an incubator in the last week in June. They were caponized August 28th. The weight and breeding was as follows:

	Weight Pounds.
5 Partridge Cochins	14.
2 Buff Cochins	5.5
5 White P. Rocks	13
6 Barred P. Rocks	13
2 Cornish Indian Games	7.5
2 Dark Brahmas	6
5 Golden Wyandottes	14
2 Black Langshans	8.5
1 Silver P. Hamburg	1.5
1 Single C. B. Leghorn	2
9 Cross C. I. Game—P. Cochins	20
4 Cross C. I. Game—W. P. Rocks	12
6 Grad eB. Leghorn and Plymouth Rocks	10.5
50	127.5

The average weight was 2.55 pounds.

One of the Game-Cochin capons died September 24th, weighing at that time 3.5 pounds. Two of the Barred Plymouth Rocks died September 29th, weighing 5.5 pounds. One P. Cochin died December 12th, weighing 8.5 pounds and another of the same breed December 28th, weighing 7 pounds and three ounces. A C. I. Game-P. Cochin died December 25th, weighing 7.5 pounds. There was left in the pen January 1, therefore, forty-four capons. A Barred Plymouth Rock was sold January 18th, weight 9 pounds, at seven cents per pound. Two grades were sold one February 7, and the other February 14, at the same price per pound, they weighed together 10 pounds.

The remaining forty-one birds were sold March 1st, when they weighed as follows:

	Average weight Sept. 1.	Average weight Mar. 1.	Total weight Mar. 1.
4 Partridge Cochins	2.8	8.6	34.4
2 Buff Cochins	2.75	9.5	19.0
5 White Plymouth Rocks	2.6	7.6	38.2
3 Barred Plymouth Rocks	2.1	6.6	19.7
2 Cornish Indian Games	3.8	8.7	17.4
2 Dark Brahmas	3.0	9.7	19.3
5 Golden Wyandottes	2.8	8.0	39.9
1 Silver Penciled Hamburg	1.5	4.2	4.2
2 Black Langshans	4.2	11.0	22.1
1 Single Comb B. Leghorn	2.0	5.1	5.1
6 Cross C. I. Game—P. Cochin	2.2	8.5	51.3
4 Cross C. I. Game—W. P. Rocks	3.0	11.0	43.3
4 Grades	1.7	5.5	22.1
			336.0

The feed consumed and the values are given next:

743	pounds	corn at 70c	$5 20
236	‘‘	table scraps at 2c	4 72
120	‘‘	wheat at 65c per bushel	1 30
74	‘‘	bran at 70c	52
80	‘‘	oats at 20c per bushel	50
			$12.24

On September 1st, the capons were worth at the market price eight cents per pound, the 127.5 pounds could have been sold, therefore, for $10.20. Adding the cost of the feed, $12.24, the total cost of the capons excluding labor was $22.44. Adding the amounts received for the fowls sold January and February to the 336 pounds sold March 1st at eight cents per pound we have the total receipts $27.66, which exceeds the cost of the chickens with the cost of the feed by $5.22. This is true when the value per pound of the capons in the spring is the same as the market price of the chickens in the fall. As a matter of fact the price of capons per pound in the early spring or late winter is almost universally two or three cents higher than chickens bring in the fall.

A study of the gains made by the different breeds in the table just given will bring out some indications as to which breed may be adapted to this purpose.

A STUDY OF NORMAL TEMPERATURES AND THE TUBERCULIN TEST.

CHARLES E. MARSHALL.

Bulletin 159.—Bacteriological Department.

At intervals this station will publish a series of bulletins relating to experimental work with tuberculosis in cattle. This work was begun in the year 1896 and is in progress at the present time.

The work already done by investigators throughout the world in studying this subject has become so exhaustive that to establish anything new would hardly be anticipated and is not our primary purpose. This does not mean that the knowledge already acquired is sufficient and satisfactory or that the field is barren, but rather that those results following immediately upon the discovery of the tubercle bacillus by Koch in 1882 and his tuberculin in 1890, with the valuable accumulations of scores of other workers have left largely a work of detail and of mystery difficult to solve. Moreover, it lies in our domain principally to verify what is already at hand and to render it applicable to the farmers who are looking for recommendations in the management of tuberculous animals.

Recommendations must necessarily be slow in coming because much time must first be consumed in establishing our knowledge to the satisfaction of all interested. The element of doubt must be eliminated so far as possible. There is already an abundance of literature before the public to present the situation in its present true light, yet we must not seize upon it too greedily and rush headlong into the destruction of property as usually recommended, until we are justified in so doing by actual experience. Conservatism should prevail where radicalism has prevailed. We are too apt in conveying a partial truth as a universal. The neglect of errors should not be concealed through strategy, but should be presented as faithfully as the satisfactory results which our preconceived notions are expecting. Our readers should know where to anticipate error or failure to be successful.

In discussing the matter of normal temperatures and the tuberculin test, there may be reason for apologizing, since nearly every experiment station in the Union has contributed its share in the tuberculin test to the public, sometime in the past, in some cases, some years ago. Periodicals in certain quarters have properly refused to publish anything farther as regular tuberculin tests. We conclude from this that the tuberculin test has been generally accepted. No one familiar with this test now doubts its value; no one regards it as infallible; many, however, do differ in its application and interpretation. To the last theme, we shall give the weight of our attention.

Inasmuch as we are intending to place the complete records of the work with tuberculosis before our readers, it is expedient that we publish the complete records of the tuberculin test of the college herd. In so doing the test history of every animal will be constantly at hand for consultation, if we should have occasion hereafter to refer to it, and should, as we may expect, any of the animals not condemned at the present time react in the future. These records will be complete to the present time; and if anything of interest occurs in connection with the tests later, we shall publish it in due season.

We therefore have a two-fold object in view: First, to discuss the application and interpretation of the test; second, to place on record the tests as applied to the college herd.

It is pertinent at the start that no one sufficiently interested in the tuberculin test to study it for practical application should be satisfied with the perusal of a single experience. A comparative and close study is essential even after abundant personal experience may be brought to his aid.

WHAT IS TUBERCULIN ?

Tuberculin was discovered by Koch in 1890 and considered by him as a specific cure for tuberculosis. [Its value as a cure may be discussed in a later bulletin.—Author.]

Several months passed before he made known to the scientific world its preparation. This was done through the Deutsche Medicinische Wochenschrift in October of 1891. A meat infusion to which was added four to six per cent. of glycerine and one per cent. of dry pepton was placed in wide bottom flasks. These had been previously plugged with cotton wool and sterilized. The flasks with their contents were then sterilized in steam. They were now ready for inoculation with tubercle bacilli taken from a pure culture. Some of the germs were floated on the surface of this food material; if the germs dropped to the bottom of the flask there would be little growth. After an interval of about six weeks there had formed a decided yellowish white scum over the surface of the infusion which began to break up into small patches and fall to the bottom. At this time it was concentrated to one-tenth its bulk and passed through an unglazed porcelain filter to remove the germ sediment. This gave a clear solution of tuberculin containing forty to sixty per cent. of glycerine. The tuberculin is in solution and in this form is used. It can be precipitated with alcohol; that is, upon the addition of alcohol a white precipitate is thrown down which contains within it the active property of tuberculin, but it cannot be regarded as pure tuberculin because of the associated material which may also be precipitated with alcohol.

The action of tuberculin is very peculiar; it is not strange that Koch and his followers were led astray in regard to its curative properties. They noticed in their first use of it that when a very small amount even less than one milligram was hypodermically injected a marked rise of temperature would follow in tuberculous subjects, while sound subjects would show no febrile reaction at all. Also, immediately about the tuberculous lesion, if it were on the surface of the body and could be watched, there would be a marked inflammation and many times sloughing away of part or all of the diseased tissue. The tubercle bacilli were not in the least injured by this change, and it was thought that in many cases this broken down tuberculous tissue would be disseminated throughout the body producing a generalized tuberculosis, in this way aggravating the condition very much.

De Schweinitz and Dorset, from cultures of tubercle bacilli grown upon a special cultural medium, have isolated a temperature reducing and a temperature producing substance, the latter of which is much the same, if not identical with tuberculin in raising the temperature, but much more intense and effective. It is hoped that our crude tuberculin will some day be simplified and made more reliable and constant. For if we are to judge from the sentiments expressed by Babes and Proco of the intimate relation of the germ-body to tuberculin, and of Koch in the preparation of his new tuberculin, we should be led to believe that this agent has a future which has not yet been conceived and that the percentage of error will still be lowered. The present indefiniteness of its component action can only result in the determination of its perhaps several constituents, one of which shall only be necessary for increased temperature production in tuberculous subjects.

HOW IS TUBERCULIN APPLIED?

In the treatment of this subject, we shall confine ourselves to its use in the diagnosis of tuberculosis in cattle.

The general principles underlying nearly all methods are: The ascertaining of the normal temperature; the injection of tuberculin; and, after an interval of a few hours, the taking of temperatures during a period of several hours. We can best gain a practical understanding by reviewing the recommendations and work of others.

The Bureau of Animal Industry at Washington, D. C., recommends the following course in using their tuberculin:

"1. Begin to take the rectal temperature at 6 a. m. and take every hour thereafter until midnight.

"2. Make the injection at midnight.

"3. Begin to take the temperature next morning at 6 a. m. and continue as on preceding day."

To those who have large herds to examine, or who are unable to give the time required by the above directions, the following shortened course is recommended:

"1. Begin to take the temperature at 8 a. m. and continue every two hours until 10 p. m. (omitting at 8 p. m., if more convenient).

"2. Make the injection at 10 p. m.

"3. Take the temperature next morning at 6 or 8 a. m., and every two hours thereafter until 6 or 8 p. m."

The Pasteur Vaccine Co. of Chicago gives these directions in the use of its tuberculin: "Before giving the injection, obtain the normal temperature. From the tenth to the twentieth hour after injection take the temperature every two hours. [Strictly speaking, it is sufficient to take the temperature only three times after injection, at the twelfth, fifteenth, and eighteenth hours; but it is preferable to take the temperature every two hours.]

"It is well to take the temperature morning and evening for several days prior to injection. It happens sometimes that healthy animals show considerable variations in temperature; this is only temporary, and appears to be due to a slight momentary disarrangement of the digestive organs. It must also be remembered that when a cow is ready to 'bull' her temperature rises nearly two degrees. It is better to postpone the test with animals whose temperature is thus affected."

The directions issued must necessarily differ widely from the very nature of the case; each man giving his own version of the number of temperatures required before and after injection. This variation of application extends even to competent workers who do not deem it obligatory to adhere to any fixed rule of application. Russell (Wis.) in his report on the tuberculin test varied his methods considerably.

In his first test he took the temperatures before injection as follows: 4 p. m., 6 a. m., 8 a. m., 12 m., 4 p. m., 8 p. m., and after injection 6 hours, 8 hours, 9 hours, 10 hours, 11 hours, 12 hours, 14 hours, 16 hours, 18 hours, 20 hours, 24 hours, 28 hours, 40 hours. In the second test the temperatures before injection are represented by 4 p. m., 6 a. m., 12 m., 3 p. m., and after injection 5 hours, 8 hours, 10 hours, 13 hours, 16 hours, 18 hours, 20 hours, 24 hours.

Paige records a single normal temperature before injection, in one case at 4 p. m., in another at 4:30 p. m., and still another at 7 p. m. After injection the temperatures were taken at 6½ hours, 11½ hours, 15½ hours, 19 hours, 23 hours, 26 hours, or in some instances covering about the same duration and intervals of time. We note a similar method employed by Armsby, the normal temperature recorded only at the time of injection. Niles also makes use of this method. From what I have been able to learn, I would conclude that a single normal temperature before injection is a common method of veterinarians over the country. Curtice thinks two normal temperatures sufficient. We shall have occasion to say something about this before completing this bulletin. Uniformity may not be essential, yet a single temperature may represent too brief a process.

WHERE INJECT THE TUBERCULIN?

It matters little where the tuberculin is injected. The neck or shoulder is usually selected. From my own standpoint the shoulder offers greater advantages as recommended by Curtice: there is little subcutaneous tissue if infection from foreign bacteria should occur while injecting, the skin is tense, and the shoulder is generally quiet while the neck may be in constant motion. The febrile constituent of the tuberculin is comparatively quickly diffused throughout the body no matter where injected.

THE AMOUNT OF TUBERCULIN INJECTED.

The amount of tuberculin (crude) necessary to produce a febrile condition in a tuberculous animal is quite variable, depending somewhat upon the size of the animal, small animals requiring less than large ones. There also appear, so far as we are able to conjecture, although it is not satisfactorily established, stages of the disease which require more or less. In very advanced cases a large amount is indicated in the judgment of experienced operators. Koch ascertained that one milligram or less of tuberculin was sufficient to produce a rise of temperature in a man suffering from tuberculosis while it produced no effect in a sound man. The Bureau tuberculin is given in doses of 2 c. c. to full grown cattle. This tuberculin, however, is sent out by the Bureau in a diluted form. One-tenth, two-tenths, or three-tenths cubic centimeters of the concentrated tuberculin is considered sufficient for a single animal. This concentrated form may be procured from commercial houses, but it is always better to dilute it with an one-half per cent. solution of carbolic acid to make a wholesome dose and one which may readily be handled with a certain degree of security.

DISINFECTION OF THE PART INJECTED.

The place selected on the animal for injection should be properly disinfected with a five per cent. solution of carbolic acid or a solution of corrosive sublimate (one part of corrosive sublimate to one thousand parts of water). The spot should be thoroughly washed with either of these solutions. This is to prevent infection while injecting. The syringes and needles should be kept sterile and free from contamination.

THE DIAGNOSTIC VALUE OF TUBERCULIN.

What value tuberculin possesses as a diagnostic agent could be readily stated, if we should confine our thoughts to our own experience. Ours is, however, the experience of only one and there are many others who do not think exactly as we do. For a man to satisfy himself with his own cooped up experience and then scatter it broadcast as the only correct experience is belittling and obnoxiously unfair. Experimental work without a large amount of comparative study means little and does much harm. While I shall give what evidence I possess before completing this bulletin, I should feel that a larger part had been omitted did I not present some experiments and opinions of a few other workers based upon their own experience.

Soon after Koch announced the discovery of his tuberculin and when scores of investigators were endeavoring to ascertain its physiologic action, Gutman of Dorfat made use of it December 25, 1890, upon some cattle. The rectal temperatures were taken at noon of the day of the injection and found to be 28.1° C, 38.5° C and 39° C. After the injection the maximum temperature reached 40° C, 40.8° C and 41.3° C respectively. The fever lasted four, nine and twelve hours. Sticker at about the same period reached almost identical conclusions as Gutman. The former did his work in Russia and the latter at Cologne, Prussia. Simultaneously with these two workers, at a French veterinary school, experiments of the same nature were in progress. The conclusions were practically the same, that is, tuberculin produced a rise of temperature in tuberculous animals.

In 1891 Eber summed up results with tuberculin. He showed that of one hundred thirty-four cattle which reacted to tuberculin and autopsied. eighty-five and eighty-three one-hundredths per cent. were tuberculous.

Of one hundred thirteen which showed no reaction after the injection of tuberculin and were killed, eighty-nine and thirty-eight one-hundredths per cent. were free from tuberculosis. This demonstrates, throwing aside all possibility of error in determining the disease as must be done in every case, that there were fourteen and eighteen one-hundredths per cent. of failures in the cases condemned by the reaction and ten and sixty-two one-hundredths per cent. of failures where there was no reaction. The importance of this summary cannot be overestimated.

In reviewing the reports and opinions of tuberculin as a diagnostic agent the Lancet of March 21, 1891, has the following to say: "The importance of a new aid to the diagnosis of tubercular disease within the body is obvious, not only as enabling one to differentiate it from allied conditions, but as a guide to the early adoption of therapeutical measures. In Koch's tuberculin it was hoped that we should possess a divining-rod which would reveal the hidden foci of an insidious malady, and there were many who declared that therein would lie its chief value. Experience, however, as embodied in these reports, compels but a guarded acceptance of this opinion. A few observers such as Professors Lichtheim and Schreiber of Königsberg, and Dr. P. Guttman of Berlin regard it as an efficient test, but Prof. Leyden (Berlin) thinks it cannot be solely relied upon, and Prof. Gerhardt says that no reaction was observed in some cases when bacilli were present. Prof. Ebstein (Göttingen), who appears to have been the least impressed of all with the value of the remedy, does not think there is any absolute certainty in its use for diagnostic purposes. Prof. Biermer (Breslau) is also very cautious; he had two cases of undoubted tuberculosis with bacillary expectoration, which gave no reaction, either local or general; while in another case, of alcohol tabes, with no suspicion of tubercle, there was a marked general reaction. Prof. Quincke (Kiel) thought it gave more certain indications in cases of slight lung disease, but could not admit there was latent tubercle in every case in which a general reaction followed the injection. The Greifswald professors—Mosler, Strubing, and Peiper,—speak with somewhat more confidence, whilst Professor Schultze of Bonn thinks it a test within limits and Professor Weber of Halle that it is far less certain diagnostically in internal than in external tubercle. Professor Finkler of Bonn met with but few exceptions to the rule of reaction among cases of commencing phthisis, and did not regard the absence of reaction in chronic phthisis as diminishing its value in diagnosis. Lastly, Professor Rumff (Marburg) believed it was a test which should always lead to greater care in physical exploration of the chest and in search for bacilli."

In July, 1892, Bang reviewed the work of some experimenters. Schutz and Rosval tested sixty-six animals, forty-four of which responded to the tuberculin. In ten of these which showed a reaction, traces of tuberculosis could not be found upon autopsy. In Nocard's cases, twenty cows reacted and eighteen were found to be tuberculous. The other two had liver disease and enlarged lymphatic glands. Thirty-seven cases did not react. Of these thirty-five were healthy and two affected with a mild form of tubercle.

Clement reports that out of 500 animals tested he had only a single error, 100 of these 500 reacted and were slaughtered. The error was in a case of advanced tuberculosis which failed to respond to a small dose of tuberculin.

The United States Veterinary Medical Association at their meeting in Buffalo, September, 1896, published the following:

"Whereas, Tuberculosis of some of our domestic animals, and especially of cattle, is a wide-spread and destructive disease; and

"Whereas, The statistics accumulated during the year past show that the disease is very prevalent throughout this country, especially in dairy herds, indicating that it is steadily increasing, except in states where active measures for its suppression have been enforced; and

"Whereas, There exists in some quarters a difference of opinion as to the relation of tuberculosis among cattle to the public health, notwithstanding the fact that this matter has been the object of careful scientific inquiry by a great number of eminent scientists in all parts of the world, and that reliable and uniform observations are recorded in great numbers in the veterinary and medical literature, by it;

"Resolved, That it is the opinion of the United States Veterinary Medical Association that the following points have been demonstrated beyond dispute and may be accepted as fully established: First, that tuberculosis of man and cattle is identical; second, that the milk from cows with tuberculous udders may cause tuberculosis in animals fed upon it; third, that the milk from cows with extensive tuberculosis, but apparently healthy udders, may, in some cases, contain the germ of tuberculosis, and cause the disease in animals fed upon it; fourth, that in some cases the germs of tuberculosis appear in the milk of tuberculous cows that are not far advanced in the disease, and of others that are healthy, so far as can be determined by an examination made during the life of the animal; fifth, slightly tuberculous cows sometimes succumb to the sudden exacerbation of tuberculosis and furnish virulent milk for a period before it is possible to discover their conditions by means of physical examination; sixth, tuberculin furnishes incomparably the best means of recognizing tuberculosis in the living animal; seventh, tuberculin, properly used for diagnostic purposes, is entirely harmless to healthy cattle and is so exceedingly accurate in its effects that the few errors resulting in its use cannot affect the general results, and are of less frequent occurrence than following the use of any other method of diagnosing internal diseases; eighth, that the carcasses of tuberculous animals may be and sometimes are dangerous to the consumer, and all carcasses should be subject to a rigid inspection by a competent veterinarian, and those that are condemned should be disposed of in such a manner that it will be impossible to put them on the market for consumption as human food; ninth, that the importance of dairy inspection cannot be overestimated, and municipal and health authorities should at once perfect a system commensurate with the vast importance of the subject.

"Resolved, That the live stock, and especially the breeding interests of this country can never regain their former prosperity until such measures have been carried out by the National and State governments as will afford some reasonable guaranty against the continued ravages of this disease. And, in view of the prevalence of bovine tuberculosis in foreign countries and the measures taken by some of them to protect their cattle from infection, the United States should prohibit the importation of breeding animals until they have been proven by the tuberculin test to be free from the disease."

Nocard, an ardent admirer of tuberculin, says: "Every one admits to-day the exactitude and marvellous precision of the diagnostic indications furnished by tuberculin."

Grange says: "Tuberculin is now recognized the world over as the most reliable, safe and practical method of diagnosing tuberculosis." Out of 849 tested animals he found 107 which reacted. These cattle were cattle generally suspected before the application of the test. Grange says further: "I have used tuberculin in upwards of a thousand instances in this State (Michigan) during the past two years and have not discovered a case in all these which would impeach the test."

In the earlier days of testing tuberculin, the per cent. of error due to tuberculin appears greater than in more recent time. The investigators who usually carried out these experiments were trained scientific men. After the test had been applied a careful examination was made of every animal tested and it was usually found that the per cent. of error was not unnoticably small either where the tuberculin failed to detect tuberculosis or where a rise of temperature occurred, sufficient to condemn the animal, probably from some other source than tuberculin. Still tuberculin must be regarded as an excellent diagnostic inasmuch as it is far superior to any clinical methods now known.

While the statistics offered by practitioners are interesting and exceedingly valuable, they cannot be regarded as accurate or unquestionable, for the practitioners were concerned only in establishing tuberculosis in the cattle they had condemned by the use of tuberculin. It is the best that can be done under the circumstances and I do not impeach their work. The objections I would offer to such statistics as truly accurate are:

1. Tuberculin tests are applied under the assumption that they are infallible.
2. Such an assumption necessarily leads to inaccuracy.
3. The condemned animals only are slaughtered for the purpose of examination.
4. Exact examinations are not always made of the supposed tuberculous lesions, if any are found.
5. The number of tuberculous animals remaining behind because of a failure to react cannot be estimated.

For these reasons the ordinary reports of tests which involve thousands of animals cannot be regarded as an exact test of tuberculin, and can only be looked upon as a proof of the value of tuberculin. Clinicians' reports are never used as a basis to compute the exactness of knowledge; if this were not so, tuberculosis would have long ago been eradicated by reports of cures, testimonials and various remedies.

In the spring of 1896 Prof. Grange began the work of eradicating tuberculosis from the college herd and he conscientiously followed up the work till the summer of 1897 when he became dean of the veterinary department of the Detroit Medical College. This work was done by the use of tuberculin, and, inasmuch as his report will follow in this bulletin, I am glad to give the methods he employed as stated by him in his report to the Live Stock Sanitary Commission when he was State Veterinarian: "The plan which I have adopted for applying the test is, substantially that which has been recommended by the Bureau of Animal Industry of the Department of Agriculture at Washington, D. C., which suggests that the temperature of the animal to which the test is to be applied shall be taken every two hours during the day previous to the injection of the fluid. About ten o'clock at night the fluid is introduced beneath the skin of the animal—about a half teaspoonful of the fluid which has previously been diluted for convenience in handling. It is customary to administer about half the dose to yearlings and two-year-olds, while very large cows and male animals received about a teaspoonful. It has been my custom to leave the animals to themselves after injecting for about eight hours, when the temperature is again taken, and observations of the heat of the animal's body should be made every hour during the day after the tuberculin has been administered. My observation has been that those animals which are affected with the disease begin to react about nine or ten hours after the medicine has been given and continue to do so for about four or five hours when the temperature will begin to fall and soon reach the normal. There is, however, considerable variation in individuals in their behavior as to the time and degree of reaction towards the medicine. It is customary to regard an animal as affected with the disease when it shows a temperature two degrees above the highest point of the day previous to the administration of the medicine. In cases where the reaction is less than two degrees it has been my practice, where I have had full control of the herd, to place such animal in the doubtful list to be retested at a future time."

Since Professor Grange has been connected with this work of the station, I wish to quote him further in regard to his idea of the interpretation of the tuberculin test. There is ample room for different interpretations and I desire that his reports shall fairly represent his views. His interest in this work has remained unabated.

"A brief account of some animals which were placed in the doubtful list, will, no doubt, impress the reader with the very great importance of careful manipulation of the thermometer in reading it, and also impress upon him the advisability of retesting animals which have shown the slightest indication towards a rise in temperature the day after the fluid has been given.

"On the 31st of March, 1896, I tested a herd of 67 cattle. Among them nine animals reacted in a manner indicating tuberculosis, while 18 of them dropped into the doubtful list, one of which only reacted one-tenth of one degree, another three-tenths of a degree, another six-tenths of a degree, and still another one degree and eight-tenths. On the 11th of May these animals were retested. The first one reacted two degrees and six-tenths, the second one, six-tenths of a degree, the third one, one degree and five-tenths, the fourth, two degrees. The first and fourth were condemned according to the requirements of the test. The fourth animal was badly affected with the disease which was very apparent upon the most casual observation. The first one, or No. 1, although reacting two degrees and six-tenths did not show any external manifestations of the disease but was killed and after a diligent search some of the cheesy tubercle was discovered. Not being satisfied with the ocular examination, the microscope was used when the bacillus was discovered. Besides this, some of the material was inserted beneath the skin of a Guinea pig which eventually died of tuberculosis and in this animal the germs could readily be seen when stained according to Ziehl's method. No. 4 was also killed and showed such exaggerated lesions of tuberculosis that nothing more was done so far as studying the disease in her was concerned. Nos. 2 and 3 were again retested in August, No. 2 reacting two degrees and eight-tenths, No. 3 reacting one degree and eight-tenths. The latter two are at the present time being held for experimental purposes. It is worthy of note that three of the four animals would not have been considered as being affected with the disease according to the methods adopted in trans-atlantic countries where it is stated, according to a description of the application of the test in a volume written by Nocard: 'Elevations of temperature of less than eight-tenths of a degree have no meaning. Every animal whose temperature indicates an elevation between eight-tenths of a degree and one degree and four-tenths must be considered under suspicion and will have to undergo, after an interval of a month or so, a new injection of a larger dose of tuberculin. [These temperatures are stated by Nocard according to the centigrade system .8 C.=1.44° F., 1.4° C.=2.52 F. This may be a little misleading as it stands without designating what system is meant. Prof. Grange used the Fahrenheit system.—Author.] It is probably owing to the fact that sufficient importance has not been attached to the minutest elevation in temperature that tuberculin has been wrongfully blamed for missing cases that were afterwards shown to be affected with the disease. Setting the condemning figure at one and four-tenths (this should be translated as centigrade.—Author) or two degrees is only arbitrary as far as I am aware. Experience with tuberculin has caused me to believe that if this agent causes the elevation of temperature, even to a slight extent, it is an indication of tuberculosis. Unfortunately we are not able to tell whether it is the tuberculin or something else which causes this elevation, so a wide margin is taken and set at two degrees and mistakes are reduced to the minimum in careful hands."

Since the testing of the college herd has fallen to my lot, I have attempted to establish the value of the tuberculin in an indirect manner, and have endeavored to find what significance an arbitrary point of condemnation has, besides the primary effort to eradicate tuberculosis from the herd.

By saying I have tried to ascertain the value of tuberculin in an indirect manner, I mean especially the errors which are possible during the tuberculin test, which, in all probability, do not result from tuberculin itself but rather from our inability to understand the cases which arise. They are perplexing and confuse our clear conceptions of the tuberculin test. Neither the eye of a skilled veterinarian nor the hand of a careful manipulator is capable of revealing the cause of these functional disturbances which produce a wide range of variability in an apparently normal condition. Speculation in a learned professional way only makes our ignorance more intense and until science can give us the truth we might as well state flat-footed that it is beyond us. Indigestion, the common answer, may be correct, nervous excitability may be correct, cold may be correct and a dozen other answers may be correct, but we are usually unable to detect which one of a dozen possible disorders is the momentary or prolonged cause, and if this disarrangement should occur while taking the temperatures after the injection, who is going to tell whether it is the action of the tuberculin or some other agent? Fortunately, however, the chances stand about 9 to 1 in favor of the tuberculin. For this reason we are safe in recommending tuberculin with the possibility of this error. To eliminate all error so far as possible in making the test, we have not allowed anything to stand in the way. A detailed description of how we proceeded may be in order to justify us in saying that so far as practicable we tried to obtain the truth.

Thermometers.—Much is said about the use of thermometers. It is true that thermometers may lead astray; not only the thermometer itself but the reader also. For our use we obtained the English Hick's clinical thermometers with patent lens front to facilitate reading. The thermometers are self-registering and have an indestructible index which will not become obliterated by frequent use. The certificate of examination and correction accompanies each thermometer. These thermometers are very expensive, costing in the neighborhood of $2.50 each at retail prices, consequently cannot be recommended for ordinary testing. I believe these thermometers are correct, for in the various tests I have made of them I have not found them otherwise than represented. If error has occurred in my work, I cannot attribute it in any large part to the thermometer.

In using the thermometers I bound them at the lower and upper ends to a strong glass rod about one quarter inch in diameter. This was done for the purpose of protecting the fragile thermometers and of keeping them clean with a disinfecting solution. The metallic cases commonly used for protection cannot be kept clean, and they do not give as free exposure to the bulb of the thermometer as when attached to a glass rod. For ordinary work, however, I do not think that I would substitute the glass rod for the metallic case, for the metallic case gives greater protection to the thermometer and there is less likelihood of breaking. To the upper end of the glass rod and thermometer a string is tied which has a hook on the end. This enables the operator to hook the thermometer, when inserted, to a string which is stretched around the cow in front of her hips.

In managing the thermometer, the operator first shakes it down below the 97° mark; this is checked by the recorder of temperatures who accompanies him. The thermometer is then inserted into the rectum to its very top end and the hook attached to the string around the body to prevent falling to the floor should the animal defecate suddenly. Three minutes are allowed for the necessary time to obtain the correct temperature of the animal. The time is put down on paper by the recorder when the operator calls out its insertion; and the thermometer is taken out only when the three minutes are up by the watch. The operator withdraws it when so ordered by the recorder, carefully wipes it off so that the index may be easily seen by the reader, hands it first to the recorder who reads it in silence. The recorder hands it then to the operator who reads it aloud. If the readings check each other, it is then recorded; if not they study it carefully till they can agree. If there is any plausible question about the temperature, they take the temperature again. After the reading, the mercury is shaken down by the operator below 97° and checked by the recorder. The thermometer is carefully wiped off and dipped into a disinfecting solution. From this the end is dipped into carbol-vaseline and inserted into the next cow.

The checking system I deem very essential for accurate results, for even old readers are likely to make serious errors after the monotony is on, and new readers make many and very grave blunders, but by constant correction they soon become able readers. After three hours of steady employment, they make no more failures than do old readers. They become very proficient.

Hours of Temperatures.—From the first I have given much attention to the study of normal temperatures. In my first test last summer, two days were given to the study of normal temperatures just as if I were applying a regular test with this exception, we did not take the two and three hours in the early morning. Temperatures were taken every hour beginning at 7 o'clock in the morning and closing at 6 o'clock in the afternoon with one hour out for dinner. One day was allowed to elapse for the cows to rest and return to normal conditions and circumstances. The normal temperatures were again taken for another day, the tuberculin injected that night and temperatures resumed eight hours after injection and carried on till six o'clock at night with hours for breakfast and dinner out. To do good work the operators and recorders should not be allowed to grow tired. During the test in the fall, we took three days continuous temperatures, two normal and one after injection. This method was found to be unsatisfactory because the cattle became restless the third day. In the test this spring we went back to our first plan.

Injection.—We use the tuberculin prepared by the Bureau of Animal Industry, Washington, D. C. One c.c. is injected into calves, 2 c.c., into ordinary size cattle and 3 c.c. into large animals. For the purpose of injection, a syringe with two holes for the fingers to hold it and one for the thumb to work the piston is made of a glass barrel with a metallic case. The nozzle for the needle is smooth instead of the screw, thus allowing the removal and placing of the needle with ease. The needles are about two inches long and made of steel. There should be several of them. While injecting, the extra needles are kept in a disinfecting solution and should be changed with each cow.

The place of injection on the cow must be thoroughly disinfected. I do not deem the clipping of the hair necessary, although it may be a wise precaution. The syringe ready and the shoulder disinfected, the injection may be easily made with sharp needles. The operator should see that his hands and syringe are constantly disinfected. With sufficient help the injection may be done quickly. Great care, I repeat, should be exercised in obtaining the right kind of needles. My experience with poor needles forces me to make this emphatic. By injecting on the opposite side of the cow from that where you take your position will be found upon trial a very desirable method in avoiding the spontaneous actions of the animal while the needle penetrates the skin.

The study of temperatures when the test is at an end is one that requires perhaps the most deliberate thought. Since there will be all degrees of variation; and when it comes to a matter of deciding whether an animal will be condemned or not, perplexities will flood the mind. There will always be suspicious animals; there will be some which react, we will say, two degrees but the reaction is confined to a single hour. Cases of various kinds will present themselves. That this phase of the subject may be thoroughly understood and appreciated, the tables as representing the work here since the spring of 1896 will be of great use.

Key to the animals of the tables.

No. of animal.	Breed.	Birth.	Sex.	Name.	Breeding.
1	Jersey	April 20, 1892	Male	Rettas Averroes, 35119	Sire—Averroes, 2500. Dam—Retta of Bloomfield, 29520.
2	Short Horn	Feb. 13, 1891	Female	College Mysie 3d, Vol. 37, p. 716	Sire—Volunteer, 101205. Dam—Mysie 44, Vol. 25, p. 845.
3	"	Mar. 10, 1896	Male		Sire—Royal Mysie, 120959. Dam—Mysie, Vol. 37, p. 716.
4	Holstein	Jan. 18, 1890	Female	Belle Sarcastic, 23039	Sire—Sarcastic, 4729. Dam—Belvisia, 4553.
5	Red Polled	July 27, 1893	"	Cara (No. 9), 8393	Sire—Bower Baron, 1466. Dam—Bower Belle, 6208.
6	Holstein	April 13, 1894	"	College Belle Sarcastic, 37016	Sire—Maurice Clothilde, 17638. Dam—Belle Sarcastic, 23039
7	"	Feb. 6, 1894	"	College Rosa Bonheur, 37013	Sire—Maurice Clothilde, 17638. Dam—Rosa Bonheur 5th, 11227.
8	Jersey		"	Hallo.	
9	Holstein	Mar. 12, 1888	"	Houwtje D., 12005	Sire—Jumbo Boy, 1993 H. H. B. Dam—Houwtje, 2941.
10	"	Mar. 20, 1888	"	Rosa Bonheur 5th, 11227	Sire—Meadow Brook Chief, 1969. Dam—Rosa Bonheur, 890, H. H. B.
11	"	April 18, 1891	"	College Houwtje, 28232	Sire—Kaastra's Prince, 14770. Dam—Houwtje D, 12005.
12	"	Oct. 31, 1892	"	College Pauline America, 32857	Sire—Paul DeKol, 14634. Dam—Aaggie Wayne 3d's America, 27792.
13	"	Jan. 28, 1892	"	College Pauline Wayne, 30900.	Sire—Paul DeKol, 14634. Dam—Oakta 3d's Wayne, 23427.
14	"	Mar. 26, 1890	"	Oakta 3d's Wayne, 23427	Sire—Neptune Prince of Wayne, 5166. Dam—Oakta 3d, 3547.
15	Swiss	Mar. 3, 1892	"	Becky, 854	Sire—Werner Stauffacher, 486. Dam—Bettschard's Laubi, 717.
16	Short Horn	Mar 23, 1893	"	College Mysie 5th, Vol. 40, p. 753	Sire—Volunteer, 101205. Dam—Mysie 44, Vol. 25, p. 845.
17	"	June 29, 1892	"	College Mysie 4th, Vol. 39, p. 602	Sire—Volunteer, 101205. Dam—Mysie 44, Vol. 25, p. 845.
18	Grade		"	Milla.	
19	Hereford	Oct., 1891	"	Caprice, 51127	Sire—Star Grove 19th, 26594. Dam—Emmeline, 4501.
20	Short Horn	Mar. 29, 1894	"	College Mysie 6th, Vol. 40, p. 753	Sire—Volunteer, 101205. Dam—Mysie 44, Vol. 25, p. 845.
21	"	Jan. 3, 1892	"	College Victoria C, Vol. 39, p. 602	Sire—Volunteer, 101205. Dam—College Victoria, Vol. 31, p. 793.
22	"	Feb. 16, 1891	"	College Victoria B, Vol. 37, p 716	Sire—Volunteer, 101205. Dam—College Victoria, Vol. 31, p. 793.
23	"	Mar. 21, 1893	"	College Duchess A, Vol. 40, p. 753	Sire—Volunteer, 101205. Dam—College Duchess 4th, Vol, 35, p 772.

Key to the animals of the tables.—Continued.

No. of animal.	Breed.	Birth.	Sex.	Name.	Breeding.
24	Aberdeene-Angus	Dec. 30, 1890	Female	Baroness of Terlington, 14483	Sire—Day Star, A. M. 5307. Dam—Nellie of Hillhurst, 4918.
25	Short Horn	Jan. 29, 1886	"	College Victoria, Vol. 31, p. 793	Sire—Col. Acomb 2d, 37984. Dam—College Victoria Duchess 2d, Vol. 23, p. 17798.
26	Jersey	May 11, 1890	"	College Pogis, 75078	Sire—Lily's Nero, 19041. Dam—Pogis Barronne, 52272.
27	"	Jan. 3, 1888	"	Pogis Barronne, 52272	Sire—Pedes Stoke Pogis, 14874. Dam—Barronne, 7101.
28	"	Feb. 29, 1892	"	College Dame LeBrocq, 79449	Sire—Lily's Nero, 19041. Dam—Dame Le Brocq, 54075.
29	"	Nov. 18, 1892	"	College Pogis 2d, 101777	Sire—College Nero, 29138. Dam—College Pogis, 75078.
30	"	Mar. 27, 1894	"	Dame LeBrocq 2d, 100522	Sire—Lily's Nero, 19041. Dam—Dame LeBrocq, 54075.
31	Guernsey	Aug. 21, 1892	"	Poly's Blossom, 6376	Sire—Orient, 2567. Dam—Polyander, 2328.
32	"	Jan. 12, 1892	"	Aida 2d, 6112	Sire—Orient, 2567. Dam—Aida, 3318.
33	"	Jan. 20, 1893	"	College Chameaula	Sire—Orient, 2567. Dam—Chameaula, 2126.
34	Holstein	Nov. 11, 1894	"	College Pauline Clothilde, 39198	Sire—Maurice Clothilde, 17638. Dam—College Pauline Wayne, 30900.
35	Red Polled	July 16, 1895	"	Bower Belle (251), 6208	Sire—Bland, 1340. Dam—Letton Spotless, 4622.
36	Grade		"	Hebe.	
37	Short Horn	July 29, 1895	"	College Mysie 7th, Vol. 40, p. 753	Sire—Volunteer, 101205. Dam—College Mysie 3d, Vol 37, p. 716
38	"	Mar. 29, 1894	Male	College White Boy	Sire—Volunteer, 101205. Dam—College Duchess 4th, Vol. 35, p. 772.
39	Grade		Female	Materna.	
40	"		"		Sire— Dam—Materna.
41	Short Horn	May 12, 1882	"	Mysie 44, Vol. 25, p. 845	Sire—5th Duke of Ackland, 41734. Dam—Mysie 43, Vol. 25, p. 675.
42	"	Mar., 1896	"		Sire—Volunteer, 101205. Dam—Mysie 44, Vol. 25, p. 845.
43	"	Sept. 22, 1893	Male	Royal Mysie, 120959	Sire—Double Victor, 111558. Dam—Mysie of Pleasant 2d, Vol. 39, p. 757.
44	Swiss	May 24, 1893	"	Colonel Barton, 644	Sire—Francis B., 386 Dam—Cinderella, 625.
45	Holstein	May 22, 1895	"	Maurice Bonheur, 22,394	Sire—Maurice Clothilde, 17638. Dam—Rosa Bonheur 5th, 11227.
46	Jersey	April 28, 1895	"	General Longstreet, 40848	Sire—Tormentor's Bully, 30273. Dam—Lizzie E., 63112.
47	Red Polled	July 7, 1895	"	College Corbett 2d	Sire—Jim Corbett. Dam—Cara, 8393.

48	Short Horn	April 3, 1895	"	Mysie 4th's Volunteer	Sire—Volunteer, 10 205. Dam—Mysie 4th, Vol. 39, p. 602.
49	Jersey	Sept. 11, 1895	Female		Sire—Rettas Averroes, 3519. Dam—College Dame LeBrocq, 79449.
50	Grade	May 6, 1895	Male	College Blue Boy	Sire—Volunteer, 101205 Dam—Baroness of Terlington, 14483.
51	Short Horn	June 18, 1895	"	College Volunteer	Sire—Volunteer, 101205. Dam—College Victoria C, Vol. 39, p 602.
52	Holstein	Dec. 3, 1895	Female	College Houwtje Maid, 41760	Sire—Maurice Clothilde, 17638. Dam—Houwtje D, 12005.
53	"	Feb. 28, 1896	"	College Belle, 41761	Sire—Maurice Clothilde, 17638. Dam—Belle Sarcastic, 23039.
54	Short Horn	Nov. 19, 1895	Male		Sire—Volunteer, 101205. Dam—College Victoria B, Vol. 37, p. 716.
55	Holstein	Feb. 13, 1896	"	College Maurice Wayne, 23016	Sire—Maurice Clothilde, 17638 Dam—College Pauline Wayne, 30900.
56	Jersey	Oct. 20, 1895	Female	College Pogis 3d, 125892	Sire—Rettas Averroes, 35119. Dam—College Pogis, 75078.
57	"	Nov. 15, 1895	"	College Retta, 125893	Sire—Rettas Averroes, 35119. Dam—College Pogis 2d, 101777.
58	Holstein	April 2, 1896	Male		Sire—Maurice Clothilde, 17638. Dam—Oakta 3d's Wayne, 23427.
59	Swiss	April 2, 1896	Female	College Bravura	Sire—Col. Barton, 644. Dam—Bravura, 855.
60	Short Horn	May 2, 1896	Male	College Royal Mysie	Sire—Royal Mysie, 120959. Dam—College Mysie 5th, Vol. 40, p 753.
61	Holstein	May 25, 1896	"		Sire—Maurice Clothilde, 17638 Dam—College Pauline America, 30900
62	Short Horn	April 4, 1896	"		Sire -Royal Mysie, 120959. Dam—College Duchess A, Vol. 40, p. 753.
63	Jersey	May 6, 1896	Female	College Dora, 125894	Sire—Rettas Averroes, 35119. Dam—College Dame LeBrocq 2d, 100522.
64	Grade		"	Black Diamond	
65	"		"	White Star	
66	"		"	Blaze Croup	
67	Cross	Sept. 23, 1896	Male	Baroness Boy	Sire—Royal Mysie, 120959. Dam—Baroness of Terlington, 14483.
68	Holstein	Sept. 4, 1896	"	Bonheur Boy	Sire—Houwtje Clothilde A, 21482 Dam—College Rosa Bonheur, 37013.
69	Cross	Oct. 8, 1896	"	Caprice Boy	Sire—Royal Mysie, 120959. Dam—Caprice, 51127.
70	Galloway	June, 1895	Female	Lillie of Bath, 11691	Sire—Col. Davis, 10534. Dam—Hazel of Bath, 10140.
71	Red Polled	Sept. 19, 1896	Male	College Chandler	Sire—Duke of Chandler. Dam—Bower Belle, 6208
72	Jersey	Apr. 13, 1897	Female	College Pogis 4th, 125896	Sire—Rettas Averroes, 35119. Dam—College Pogis, 75078.
73	"	Mar. 21, 1897	Male	Baron Averroes	Sire—Rettas Averroes, 35119. Dam—Pogis Barronne, 52272.
74	Holstein	Apr. 2, 1897	Female	College Polly, 42673	Sire—Maurice Bonheur, 22394. Dam—College Pauline Clothilde, 39198.
75	Jersey	Oct. 30, 1896	"	College Retta 2d	Sire—General Longstreet, 40848. Dam—College Pogis 2d, 101777.

Key to the animals of the tables.—Concluded.

No. of animal.	Breed.	Birth.	Sex.	Name.	Breeding.
76	Holstein	Dec. 19, 1896	Female	College Houwtje 3d	Sire—Maurice Bonheur, 22394. Dam—Houwtje D, 12005.
77	Short Horn	Dec. 21, 1896	"	College Queen	Sire—Royal Mysie, 120959. Dam—College Victoria B, Vol. 37, p. 716.
78	Red Polled	Dec. 30, 1896	"	College Cara	Sire—Duke of Chandler. Dam—Cara (No. 9), 8393.
79	Holstein	Mar. 9, 1897	"	College Pauline Bonheur, 42672	Sire—Maurice Bonheur, 22394. Dam—College Pauline Wayne, 30900.
80	"	Feb. 27, 1897	"	College Rosa Bonheur Queen, 42674	Sire—Maurice Bonheur, 22394. Dam—Rosa Bonheur 5th, 11227.
81	Short Horn	Oct. 29, 1896	Male	College Royal	Sire—Royal Mysie, 120959. Dam—College Victoria C, Vol. 39, p. 602.
82	"	Feb. 27, 1897	Female	College Mysie Lassie	Sire—Royal Mysie, 120959. Dam—College Mysie 6th, Vol. 40, p. 753.
83					Dam—Poly's Blossom, 6376.
84	Cross	Nov. 2, 1896	Male	College Cross	Sire—General Longstreet, 40848. Dam—Aida 2d, 6112.
85	"	May 12, 1897	Female	College Becky	Sire—College Barton, 644. Dam—Becky, 854.
86	Grade		"		
87	"		"		
88	"		"		
89	"		"		
90	"		"		
91	"		"		
92	"		"		
93	"		"		
94	"		"		
95	"		"		
96	"		"		
97	"		"		
98	"		"		
99	"		"		
100	"		"		
101	"		"		
102	"		"		
103	"		"		
104	"		"		
105	"		"		
106	"		"		
107	"		"		
108	"		"		
109	"		"		
110	"		"		
111	"		"		

112	Holstein	Sept. 4, 1897	Male	Bonheur Boy 2d	Sire—Houwtje Clothilde A, 21482. Dam—College Rosa Bonheur, 37013.
113	"	Aug. 13, 1897	"	College Belle Sarcastic's Boy	Sire—Maurice Bonheur, 22394. Dam—College Belle Sarcastic, 37016.
114	Jersey	Aug. 13, 1897	"	Gen. Longstreet's Pogis, 48963	Sire—General Longstreet, 40848. Dam—College Pogis 3d, 75078.
115	"	Aug. 27, 1897	Female	College Pandora, 126112	Sire—General Longstreet, 40848. Dam—College Retta, 125893.
116	Grade		"		
117	Galloway	Oct. 18, 1897	"	College Lily	Sire— Dam—Lily of Bath, 11691.
118	Jersey	Oct. 15, 1897	Male	College LeBrocq's Longstreet	Sire—General Longstreet, 40848. Dam—College Dame LeBrocq, 79449.
119	Cross	Oct. 22, 1897	"	College Cross	Sire—General Longstreet, 40848. Dam—Aida 2d, 6112.
120	Holstein			Colantha Lad, 23883	Sire—Paul Mutual DeKol, 18726. Dam—Colantha 4th, 35028.
121	Short Horn	Oct. 22, 1897	Male	College Royal 2d	Sire—Royal Mysie, 120959. Dam—College Victoria C., Vol. 39, p. 602.
122	Jersey	Dec. 24, 1897	"		Sire—General Longstreet, 40848 Dam—College Dame LeBrocq 2d, 100522.
123	"	Nov. 13, 1897	Female	College Prudence, 125895	Sire—General Longstreet, 40848. Dam—College Pogis 2d, 101777.
124	Red Polled	Nov. 5, 1897	"	College Cara 2d	Sire—Duke of Chandler. Dam—Cara (No. 9), 8393.
125	Holstein	Oct. 26, 1897	"	College Oatka Bonheur	Sire—Maurice Bonheur, 22394. Dam—Oakta 3d's Wayne, 23427.
126	"	Oct. 16, 1897	Male	Houwtje Maurice Bonheur	Sire—Maurice Bonheur, 22394. Dam—College Houwtje, 28232.
127	"	Feb. 17, 1898	Female		Sire—Maurice Bonheur, 22394. Dam—College Belle, 41761.
128	"	Feb. 1, 1898	"		Sire—Maurice Bonheur, 22394. Dam—Houwtje D, 12005.
129	Short Horn	Oct. 16, 1897	"	College Mysie 8th	Sire—Royal Mysie, 120959. Dam—College Mysie 3d, Vol. 37, p. 716.
130	"	Dec. 20, 1897	Male	Mysie 5th's Royal	Sire—Royal Mysie, 120959. Dam—College Mysie 5th, Vol. 40, p. 753.
131	"	Jan. 19, 1898	"		Sire—Royal Mysie, 120959. Dam—College Mysie 4th, Vol. 39, p. 602.
132	"	Mar. 2, 1898	"		Sire—Royal Mysie, 120959. Dam—College Mysie 6th, Vol. 40, p. 753.
133	Cross	Mar. 8, 1898			Sire—Colonel Barton. Dam—College Dora, 125894.
134	Grade		Male		
135	Cross	Dec. 22, 1897	Female		Sire—Royal Mysie, 120959. Dam—Daroness of Terlington, 14483.
136	Holstein	Oct. 18, 1897	Male	Sarcastic's Lad, 23971	Sire—Maurice Bonheur, 22394 Dam—Belle Sarcastic, [illegible].

EXPLANATION OF TABLES WHICH FOLLOW.

Tables I. to VIII. inclusively represent the work of Prof. E. A. A. Grange while connected with the college.

Each day's maximal temperature is indicated by a dagger †.

Each day's minimal temperature is indicated by a double dagger ‡.

Reactions and reactionary animals are indicated at the left of the number by a +. By reactionary animals I mean those animals which have once reacted and which may or may not show a reaction thereafter. Animals which reacted in the first test are marked in each test thereafter whether there is any reaction or not.

The animals were watered between 10 a. m. and 12 n. in Tables IX. to XXI. inclusively.

The tables which follow will be used as a basis for further discussion.

TABLE I.*

No. of animal.	Am't in-jected.	Time of injec-tion.	Temperatures before injection.					Temperatures after injection.								
			March 31, 1896.					April 1, 1896.								
			8 a. m.	10 a. m.	12 n.	2 p. m.	6 p. m.	6 a. m.	7:30 a. m.	9 a. m.	10:30 a. m	12:30 p. m.	2 p. m.	3:30 p. m.	4:15 p. m.	6 p. m.
1	2 c. c.	10 p. m.	† 101	99.5	‡ 99.3	98.5	100.7	98.6	99.3	‡ 97.0	† 101.2	98.6	100.0	100.7	98.2	--------
2	2 c. c.	"	‡ 97.4	99.9	100.3	† 100.8	100.0	99.9	† 101.6	99.8	101.2	100.7	100.6	100.4	‡ 99.7	100.3
3	1 c. c.	"	† 102 3	101.6	‡ 101.0	101.7	101.1	100.7	100.6	100.8	100.9	100.6	100.9	† 101.5	‡ 100.2	--------
4	2 c. c.	"	‡ 98.7	101.0	100.5	† 101.8	100.8	100.8	100.8	† 101.5	‡ 100.6	100.8	101.4	† 101.5	† 101.5	--------
5	2 c. c	"	† 102.3	101.2	102.0	101.4	‡ 101.1	100.6	‡ 100.0	† 101.2	101.4	100.2	100.3	100.8	100.8	--------
6	2 c. c	"	† 102.2	101.8	‡ 101.2	‡ 101.2	100.8	100.5	100.9	† 102.3	102.0	100.7	‡ 99.8	100.4	100.3	--------
7	2 c. c	"	101.6	† 101.7	101.0	100.6	‡ 100.4	100.9	101.0	101.0	‡ 99.4	100.6	100.2	100.0	† 101.5	--------
8	2 c. c.	"	† 101.6	101.1	101.2	‡ 98.0	98.8	99.4	100.6	† 101.3	101.2	‡ 99.0	100.2	99.9	100.6	--------
9	2 c. c.	"	‡ 100.2	101.0	100.8	101.0	† 101.2	101.1	100.7	† 101.2	‡ 100.1	100.6	100.8	† 101.2	100.8	--------
+10	2 c. c.	"	‡ 99.0	100.6	100.8	† 101.2	100.8	100.2	100.4	101.6	‡ 100.1	101.6	102.9	† 103.3	102.6	102.6
11	2 c. c.	"	102.3	102.0	102.0	† 102.8	‡ 101.9	101.2	102.0	102.0	† 102.2	‡ 100.4	101.5	101.8	101.6	--------
12	2 c. c	"	‡ 100.6	† 102.3	101.4	101.2	100.9	100.6	101.7	† 102.0	† 102.0	‡ 99.7	101.7	101.8	101.5	--------
13	2 c. c.	"	† 102.2	101.8	‡ 101.4	102.0	‡ 101.4	† 101.7	† 101.7	100.8	‡ 98.3	100.6	100.8	101.0	101.3	--------
14	2 c. c.	"	101.4	† 102.5	102.4	101.9	‡ 101.0	101.3	† 101.9	101.8	‡ 98.8	101.0	101.0	101.2	100.7	----
15	2 c. c.	"	† 102.1	102.0	‡ 101.3	101.6	102.0	101.4	101.9	† 102.4	101.6	101.2	101.3	102.0	101.6	‡ 100.6
16	2 c. c.	"	102.1	† 102.6	102.5	† 102.6	‡ 101.8	‡ 101.4	102.2	102.6	101.8	‡ 101.4	102.0	† 102.8	† 102.8	102.0
17	2 c. c.	"	101.2	101.2	100.7	† 101.4	‡ 100.4	100.0	† 101.5	100.4	‡ 98.8	101.3	101.4	101.0	100.3	--------
18	2 c. c.	"	101.1	101.3	† 101.8	‡ 98.8	100.2	99.7	101.0	† 101.9	101.0	99.4	‡ 99.2	99.8	99.6	--------
19	2 c. c.	"	101.3	100.4	‡ 100.4	† 101.6	‡ 100.4	101.1	† 102.0	‡ 100.7	101.2	101.0	101.6	101.8	101.3	--------
20	2 c. c.	"	101.4	101.4	101.6	† 102.6	‡ 101.0	‡ 100.5	† 102.2	101.3	101.5	101.0	102.0	101.6	101.0	--------
21	2 c. c.	"	101.1	† 101.3	100.9	100.9	‡ 100.6	101.5	† 102.0	101.0	100.7	‡ 99.8	100.7	101.2	100.6	--------
+22	2 c c.	"	‡ 99.8	101.0	100.8	101.0	† 101.2	101.4	‡ 100.6	101.7	100.9	101.1	100.8	102.8	† 103.5	102.5
23	2 c. c.	"	‡ 102.0	102.6	102.9	† 103.6	102.9	102.8	102.8	† 103.0	102.2	102.2	‡ 102.0	102.5	102.5	--------
+24	2 c c.	"	† 101.2	101.0	‡ 100.2	100.3	100.8	101.0	‡ 100.6	102.0	103.0	105.4	† 105.9	103.8	104.7	104.8
25	2 c. c.	"	‡ 102.1	102.8	102.7	† 103.0	102.4	104.6	† 104.8	104.7	104.5	103.4	104.4	104.0	‡ 102.6	103.0
26	2 c. c.	"	‡ 99.0	101.2	101.1	101.4	† 102.0	101.4	‡ 100.6	101.4	‡ 100.6	100.8	101.9	101.3	† 102 0	--------
27	2 c. c.	"	101.6	102.7	† 102.9	101.4	‡ 101.1	100.4	101.2	101.6	‡ 99.3	99.6	101.1	† 101.7	101.0	--------
28	2 c. c.	"	† 101.7	‡ 101.0	‡ 101.0	101.5	‡ 101.0	101.6	101.1	‡ 99.8	100.6	100.4	101.0	† 101.8	101.4	--------
29	2 c. c.	"	† 101.8	101.2	‡ 100.8	101.6	101.3	‡ 99.9	100.7	100.7	100.4	100.6	† 101.2	100.8	100.5	--------

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* Test applied by E. A. A. Grange, V. S.

TABLE II.*

No. of animal.	Am't in-jected	Time of injec-tion.	Temperatures before injection.					Temperatures after injection.									
			March 31, 1896.					April 1, 1896.									
			8 a. m.	10 a. m.	1 p. m.	4:15 p. m.	7:45 p. m.	6 a. m.	7:30 a. m	9 a. m.	10:30 a. m.	12:30 p. m.	2 p. m.	3:30 p. m.	4:15 p. m.	6 p m.
30	2 c. c.	10 p. m	100.7	‡ 100.2	101.4	101.6	† 102.0	101.2	101.7	101.3	101.0	101.4	102.1	† 102.2	101.2	† 100.8
+31	2 c. c.	"	101.1	‡ 100.8	101.4	† 102.0	101.0	102.0	103.2	104.9	103.2	105.2	† 105.6	104.3	‡ 100.2	102.5
32	2 c. c.	"	† 102.0	101.4	‡ 100.9	101.4	101.0	100.6	101.0	100.9	100.4	100.3	100.4	† 101.2	‡ 100.2	--------
+33	2 c. c.	"	† 102.0	‡ 101.3	101.5	101.4	101.5	101.7	103.2	104.3	‡ 100.8	105.0	† 106.1	105.5	105.0	103.6
34	2 c. c.	"	101.7	101.6	† 102.0	101.4	‡ 100.8	102.0	101.3	102.4	‡ 100.0	100.4	† 103.3	102.5	101.2	100.8
35	2 c. c.	"	† 101.8	101.5	100.9	‡ 100.6	‡ 100.6	100.6	101.2	101.2	‡ 100.3	100.5	† 101.5	101.2	100.5	--------
+36	2 c. c.	"	† 102.3	102.0	101.7	101.4	‡ 100.5	‡ 101.3	103.4	104.5	102.0	105.2	† 107.5	106.8	105.6	--------
37	1 c. c.	"	101.3	‡ 100.7	† 101.4	100.9	100.9	100.8	101.6	101.3	‡ 100.6	101.3	101.4	102.0	† 102.2	100.1
38	2 c. c.	"	† 102.0	† 102.0	† 102.0	‡ 101.8	‡ 101.8	‡ 101.3	102.0	101.5	101.8	102.1	101.6	† 102.3	101.8	† 102.3
39	2 c. c.	"	101.8	‡ 101.1	101.2	† 102.2	101.4	‡ 99.8	101.2	† 102.6	102.0	101.0	101.0	100.7	101.2	102.4
40	1 c. c.	"	101.0	† 102.4	102.0	‡ 100.4	101.3	101.6	‡ 100.5	‡ 100.5	101.3	101.2	101.1	† 101.7	101.6	--------
+41	2 c. c.	"	100.6	† 100.8	100.7	100.2	‡ 100.0	‡ 100.4	100.7	102.4	‡ 100.4	104.0	† 104.4	102.8	101.4	--------
+42	1 c. c.	"	‡ 100.8	101.2	101.5	† 101.9	101.0	‡ 102.7	102.9	† 104.4	103.8	103.8	† 104.4	103.6	103.5	--------
43	2 c. c.	"	† 102.0	‡ 100.6	101.1	101.5	101.4	‡ 100.0	101.2	101.0	‡ 100.0	100.5	100.5	† 101.3	101.1	--------
44	2 c. c.	"	101.0	‡ 99.8	100.6	101.0	† 101.4	100.9	100.4	100.0	‡ 99.3	99.5	100.5	100.3	† 101.2	--------
45	2 c. c.	"	101.5	101.4	† 101.6	101.0	‡ 100.8	100.9	† 102.8	102.0	‡ 100.3	100.8	100.6	100.9	100.8	101.2
46	2 c. c.	"	† 102.4	‡ 101.3	101.4	‡ 101.3	102.0	100.9	† 102.4	101.6	100.8	100.9	101.8	‡ 100.3	101.7	--------
47	1 c. c.	"	101.2	101.1	† 102.0	‡ 100.7	101.6	101.2	† 102.1	100.5	101.0	101.3	‡ 100.3	100.8	100.4	--------
48	1 c. c.	"	‡ 101.2	† 102.1	101.7	‡ 101.2	‡ 101.2	101.4	101.8	† 102.0	101.0	101.5	101.9	101.5	‡ 100.0	--------
+49	1 c. c.	"	‡ 100.4	101.3	‡ 100.4	101.2	† 102.6	‡ 101.9	102.7	103.0	103.5	104.3	105.6	† 106.0	105.6	--------
50	2 c. c.	"	100.8	100.6	‡ 101.2	† 101.3	‡ 100.4	‡ 101.1	101.8	101.4	101.5	101.4	† 102.3	102.0	101.8	102.0
51	1 c. c.	"	‡ 101.2	101.4	101.4	‡ 101.2	† 101.8	101.9	† 102.0	100.8	‡ 100.3	101.0	100.6	101.4	100.8	--------
52	1 c. c.	"	‡ 101.0	† 101.5	† 101.5	101.2	101.2	100.6	100.8	† 101.6	101.2	100.8	‡ 100.1	101.4	101.3	--------
53	1 c. c.	"	‡ 99.8	† 102.9	102.4	100.8	101.4	101.6	† 102.0	101.0	101.3	101.5	‡ 100.4	100.7	101.1	--------
54	1 c. c.	"	† 103.5	102.1	102.6	102.6	‡ 102.0	† 102.5	101.1	101.4	‡ 100.3	101.0	101.6	101.3	101.0	--------
55	1 c. c.	"	101.3	‡ 100.8	101.2	† 102.3	‡ 100.8	† 101.8	‡ 100.4	100.9	101.0	101.4	101.3	100.6	‡ 100.4	--------
56	1 c. c.	"	‡ 100.0	101.0	† 101.3	101.1	100.7	101.4	101.0	101.6	101.2	101.2	‡ 100.5	101.2	† 101.7	101.0
57	1 c. c.	"	101.0	‡ 100.3	† 101.9	101.5	101.8	† 101.4	100.8	101.0	101.0	† 101.4	101.0	‡ 100.5	101.3	--------

* Test applied by E. A. A. Grange, V. S.

TABLE III.*

No. of animal.	Temperatures before injection.						Temperatures after injection.											
	May 11, 1896.						May 12, 1896.											
	11 a. m.	1 p. m.	3 p. m.	5:40 p. m.	7:30 p m.	9:00 p. m.	6 a. m.	7:30 a. m.	8:30 a. m.	9:30 a. m.	10:30 a. m.	11:30 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6:30 p. m.
19	---- -	102.0	102.0	101.1	‡ 100.5	† 102.1	† 101.5	101.2	‡ 100.2	101.2	100.8	100.4	100.6	101.1	100.9	100.8	101.4	101.0
2	‡ 98.6	100.6	101.3	100.8	101.2	† 101.7	100.5	100.4	100.5	101.2	100.7	‡ 100.2	100.6	100.8	† 101.3	101.0	† 101.3	101.0
30	‡ 100.2	100.9	101.2	101.4	† 101.8	† 101.8	101.8	102.1	101.4	‡ 101.1	102.2	102.6	† 103.4	102.8	103.3	103.1	102.3	102.7
34	‡ 101.1	102.0	102.3	101.6	101.6	† 102.4	101.5	101.9	† 102.6	102.0	102.0	‡ 100.1	100.9	101.3	101.2	101.2	101.0	101.3
+47	† 103.4	101.9	101.8	‡ 101.5	101.8	101.6	102.4	103.5	‡ 103.3	104.1	104.4	105.6	105.2	† 106.0	105.2	104.9	‡ 103.3	103.7
51	† 103.9	103.5	102.8	‡ 102.1	102.2	102.3	‡ 103.1	104.4	104.3	103.9	103.9	103.6	103.3	103.9	† 104.5	103.7	102.6	‡ 103.1
17	--------	† 101.4	‡ 100.9	† 101.4	† 101.4	101.0	100.9	† 101.3	101.0	100.8	100.9	100.9	‡ 100.4	100.9	‡ 100.4	100.7	101.2	101.2
21	101.2	101.6	101.7	† 102 0	‡ 101.0	101.4	101.3	101.9	101.5	101.1	† 102.0	101.1	‡ 101.0	101.4	‡ 101.0	‡ 101.0	101.5	101.3
54	† 102.7	102.1	102.5	‡ 100.5	102.0	102.3	‡ 101.1	† 102.9	102.2	102.1	102.0	101.8	101.6	101.5	101.8	102.8	102.1	101.4
+25	‡ 101.5	102.5	† 102.8	102.1	102.4	102.7	‡ 102.4	102.9	102.7	102.8	104.3	104.1	104.4	104.5	104.4	† 104.8	104.1	103.9
38	‡ 101.3	101.4	101.4	101.4	† 101.8	101.4	‡ 101.5	101.8	101.8	102.0	101.7	101.8	101.6	102.1	† 102.4	101.9	101.6	101.7
50	101.8	† 102.9	102.6	102.1	102.4	‡ 101.6	101.8	102.1	102.1	† 102.8	101.8	102.0	102.1	101.9	102.3	103.1	‡ 101.5	102.1
16	† 103.2	‡ 101.1	101.7	101.2	101.3	101.2	100.8	101.2	‡ 100.3	100.6	100.5	‡ 100.3	100.8	100.9	100.8	101.3	101.0	† 101.4
60	† 104.9	103.0	103.3	102.6	102.6	‡ 102.3	102.2	101.4	‡ 101.6	102.3	102.1	‡ 101.6	102.8	103.1	† 103.6	102.6	102.7	102.6
45	101.5	‡ 101.2	101.9	101.6	† 102.0	101.6	† 102.7	‡ 101.2	101.3	101.5	101.4	101.4	102.0	102.0	102.0	102.4	102.3	102.3
39	‡ 100.2	100.7	† 101.2	100.7	100.9	100.8	100.7	100.7	100.1	† 100.8	100.0	100.4	100.4	99.2	‡ 98.4	99.5	98.8	100.0
56	101.8	‡ 100.4	101.4	101.5	101.5	† 102.1	‡ 100.8	101.3	101.6	101.3	101.5	101.3	101.2	101.5	101.4	101.5	101.5	† 102.5
37	‡ 101.5	‡ 101.5	† 102.2	‡ 101.5	101.8	101.7	101.3	101.7	101.4	‡ 101.3	102.5	102.4	101.8	† 103.1	102.4	102.2	102.6	102.5
15	† 101.8	‡ 101.4	† 101.8	101.6	‡ 101.4	101.5	101.2	101.2	101.2	101.1	101.4	101.1	101.6	101.5	† 102.3	101.2	101.3	‡ 100.8
64	--------	101.2	101.6	‡ 101.0	102.3	† 102.5	‡ 100.7	† 102.7	102.3	102.3	102.5	102.1	102.0	101.7	102.1	101.6	101.0	101.2
65	--------	101.5	‡ 100.8	101.2	† 102.5	102.2	101.5	101.4	101.7	‡ 101.3	102.1	101.4	101.6	101.6	101.6	101.8	102.0	† 102.2
66	--------	† 102.9	‡ 101.0	102.2	102.4	102.2	101.5	102.0	101.8	102.0	100.8	101.6	102.4	101.5	101.4	102.2	‡ 100.2	† 103.5
63	--------	-------	101.6	‡ 101.0	† 102.0	101.6	‡ 101.1	101.5	† 101.7	101.3	† 101.7	101.4	101.7	101.6	101.3	‡ 101.1	101.6	101.6

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* Test applied by E. A. A. Grange, V. S.

TABLE IV.*

No. of animal.	Temperatures before injection.				Temperatures after injection.										
	August 19, 1896.				August 20, 1896.										
	8:30 a. m.	1 p. m.	4:30 p. m.	10 p. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 p. m.
62	‡ 101.0	101.1	101.9	† 103.1	102.4	102.1	101.8	101.8	101.8	102.2	‡ 101.5	102.2	102.4	† 103.2	102.8
58	‡ 102.1	102.2	† 102.8	102.7	101.9	101.8	‡ 101.7	101.8	101.9	102.2	102.5	101.9	102.0	† 102.6	102.3
59	‡ 101.9	102.4	† 103.0	† 103.0	102.4	102.1	101.6	‡ 101.2	101.7	101.5	102.5	102.2	102.2	† 102.8	† 102.8
28	‡ 100.6	101.5	102.5	† 104.0	102.5	‡ 101.2	101.5	101.3	101.7	101.9	102.4	102.8	102.7	102.5	† 103.0
15	101.4	‡ 101.3	101.4	† 101.5	101.4	101.4	101.4	‡ 101.2	101.6	101.5	† 101.7	‡ 101.2	101.6	101.6	101.5
61	‡ 101.4	102.6	† 105.0	103.2	101.5	102.0	101.5	101.8	‡ 101.4	102.4	102.7	102.8	102.9	† 103.2	102.2
63	‡ 101.6	‡ 101.6	† 102.5	102.1	101.6	101.5	‡ 101.3	101.5	102.0	102.5	102.4	102.5	† 103.2	102.6	101.5
64	‡ 101.8	‡ 101.8	† 102.3	‡ 101.8	‡ 101.2	101.6	101.7	101.5	101.7	101.9	102.3	102.2	† 102.4	102.2	101.8
65	101.3	101.6	† 101.9	‡ 101.2	‡ 100.8	101.0	101.0	101.0	101.3	101.2	101.8	101.7	† 102.2	101.8	102.0
66	† 103.1	‡ 101.9	102.0	102.3	‡ 101.0	101.6	101.4	101.5	102.0	101.7	102.4	102.4	102.8	† 103.3	102.0
51	101.5	‡ 101.0	101.5	† 101.7	101.5	101.7	101.7	† 102.3	102.0	‡ 100.6	102.2	102.0	101.4	102.0	101.6
34	101.1	‡ 101.0	† 101.6	101.4	101.1	101.8	101.4	100.9	‡ 100.6	101.1	101.1	101.8	† 101.9	101.6	101.0
30	101.0	‡ 100.7	† 101.6	101.5	‡ 100.8	101.2	101.6	101.4	101.6	102.6	102.9	† 103.4	102.7	102.6	102.0
+38	† 101.6	101.4	‡ 101.3	101.4	104.2	104.0	103.5	103.3	‡ 103.1	‡ 103.1	103.3	† 104.4	103.6	103.5	103.6
50	† 101.2	‡ 101.1	† 101.2	‡ 101.1	101.2	101.1	101.2	101.3	101.3	101.3	‡ 100.8	101.3	† 102.4	101.5	101.2
45	100.2	100.0	† 100.4	‡ 99.5	100.0	‡ 99.3	99.8	100.2	100.3	100.3	100.5	101.4	101.0	101.2	† 101.6
37	101.6	‡ 101.5	† 101.9	† 101.9	† 101.9	101.7	101.7	† 101.9	‡ 101.1	101.3	† 101.9	101.4	101.7	101.7	101.4
56	‡ 101.5	101.8	102.3	† 102.4	101.2	101.1	‡ 100.3	100.6	101.2	101.4	101.5	101.4	101.3	101.5	† 101.9

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* Test applied by E. A. A. Grange, V. S.

TABLE V.*

No of animal.	Temperatures before injection.					Temperatures after injection.									
	August 26, 1896.					August 27, 1896.									
	8 a. m.	11 a. m.	2 p m.	5 p. m.	10 p. m.	6 a. m.	8:30 a. m.	10 a. m.	11 a. m.	1 p. m.	3 p. m.	4 p m.	5 p. m.	7 p. m.
+10	‡ 99.0	101.4	101.8	† 102.1	101.6	‡ 101.6	101.8	‡ 101.6	101.8	102.1	102.8	104.0	† 105.0	104.4
+41	‡ 100.6	100.9	† 101.6	101.3	101.1	‡ 100.9	100.9	101.2	102.0	104.2	104.2	† 104.8	104.4	103.8
+42	‡ 100.5	100.6	101.8	† 102.2	101.6	‡ 101.2	‡ 101.2	101.6	101.3	101.6	101.8	102 0	† 102.5	102.3
+31	‡ 99.7	101.4	101.6	† 102.1	101.6	‡ 105.5	106.7	106.6	106.0	105.1	105.8	1 6.6	† 106.9	106.2
+24	‡ 100.8	101.8	101.4	† 103.0	101.8	‡ 102.1	103.0	102.6	103.4	103.4	103.6	103.6	† 104.4	103.3
+49	‡ 101.1	‡ 101.1	102.2	† 102.2	101.7	‡ 101.6	102.3	104.1	105.0	104.4	102.7	† 105.1	104.7	104.0
+22	‡ 100.6	100.7	100.9	† 102.1	101.7	101.0	‡ 100.8	101.3	100.9	101.1	101.4	101.2	† 102.0	101.4
+33	‡ 100.2	101.9	102.1	† 102.4	101.7	‡ 104.2	105.1	† 106.6	105.8	106.5	105.9	105.8	106.0	106.0
+51	‡ 101.2	102.4	† 102.7	101.9	101.4	101.6	101.8	‡ 101 4	101.6	101.8	1 1.8	102.2	† 103.1	102.4

No of animal.	Temperatures before injection.				Temperatures after injection.									
	October 20, 1896.				October 21, 1896.									
	9 a. m.	12 n.	3 p. m.	10 p. m.	6 a. m.	8 a. m.	9 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5:30 p. m.
64	102.4	† 103.2	‡ 101.8	102.0	101.4	101.4	101.4	101.2	101.4	‡ 101.0	‡ 101.0	† 102.4	102.0
65	101.2	† 101.8	‡ 101.0	101.4	† 102.0	‡ 100.4	101.0	101.0	101.0	‡ 100.4	‡ 100.4	101.6	101.0
66	102.0	† 103.4	102.2	‡ 101.6	‡ 101.0	101.4	† 101.6	101 0	† 101.6	‡ 101 0	101.3	101.6	101.2
67	† 103.0	† 103.0	† 103.0	‡ 102.8	102.6	102.0	‡ 101.2	102.6	101.6	102.0	101.8	† 102.8	102.0
68	‡ 101.8	102.4	† 102.6	102 3	† 101.4	101.2	101.2	‡ 100.6	101.2	† 101.4	† 101.4	† 101.4	101.0
69	‡ 102.6	‡ 102.6	† 103.0	† 103.0	102.6	‡ 101.2	102.0	102.4	† 102.8	† 102.8	† 102.8	102.6	102.6

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* Test applied by E. A. A. Grange, V. S.

TABLE VI.*

No. of animal.	Temperatures before injection.					Temperatures after injection.									
	April 20, 1897.					April 21, 1897.									
	8 a. m.	11 a. m.	2 p. m.	4:30 p. m.	8:30 p. m.	6 a. m.	7:30 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
6	† 101.4	101.0	100.2	100.5	‡ 99.6	‡ 99.9	100.2	101.0	101.0	100.9	100.4	† 101.4	101.0	100.1	100.5
39	101.3	† 101.6	‡ 100.0	100.1	‡ 100.0	100.6	‡ 100.1	100.3	† 100.9	100.4	100.5	100.7	100.4	100.5	100.8
70	101.6	† 102.3	‡ 100.9	101.7	101.0	‡ 100.9	101.1	101.3	† 101.6	101.2	101.0	101.2	101.0	101.2	101.4
5	† 102.0	101.8	† 102.0	100.7	‡ 99.9	101.0	101.9	102.4	† 102.5	101.8	101.0	102.1	101.9	101.5	‡ 100.8
27	101.1	100.9	100.4	‡ 99.0	† 101.4	101.0	‡ 100.3	100.4	† 102.3	100.9	‡ 100.3	100.4	100.5	100.6	100.8
56	† 102.3	101.7	‡ 101.4	101.7	101.8	101.4	101.1	101.6	† 101.7	101.5	101.0	101.4	101.2	100.9	‡ 100.3
57	† 101.9	† 102.0	101.0	‡ 100.6	100.9	101.3	101.4	101.3	‡ 100.7	† 101.9	101.5	† 101.9	101.4	101.4	101.1
59	† 101.6	† 101.6	101.1	‡ 100.6	‡ 100.6	101.0	101.9	† 102.2	100.8	101.9	101.4	101.4	101.6	‡ 100.6	101.6
53	† 101.9	101.5	101.0	‡ 100.8	† 101.9	101.2	100.9	101.4	† 102.3	‡ 100.5	101.2	101.3	101.7	101.0	102.1
52	† 101.6	† 101.6	‡ 100.8	101.8	101.4	101.0	101.3	102.3	† 102.7	101.3	101.9	101.6	101.4	101.7	101.7
37	† 101.5	101.0	† 101.5	‡ 100.9	101.4	‡ 101.2	102.4	104.0	105.0	105.1	105.6	† 105.9	105.4	105.2	101.9
28	101.[illegible]	101.2	† 101.3	100.6	‡ 100.4	‡ 100.8	101.2	100.9	101.0	101.1	101.0	† 101.3	101.1	101.1	101.0
14	101.0	† 101.4	101.2	‡ 99.2	100.8	‡ 100.2	101.0	† 102.6	102.3	101.4	101.4	101.5	101.2	101.3	100.4
46	100.9	† 101.3	100.9	† 101.3	‡ 100.5	100.2	101.5	102.0	† 102.8	100.4	‡ 99.5	100.0	100.6	100.8	100.6
2	101.1	101.1	† 101.2	‡ 100.9	100.1	‡ 99.8	101.4	100.5	101.4	100.6	100.8	101.0	100.8	101.4	† 101.5
71	100.9	‡ 99.6	100.6	† 101.4	101.3	‡ 100.4	101.3	100.9	100.9	101.2	† 101.4	100.6	101.3	101.2	100.8
43	‡ 99.9	100.4	101.0	† 101.4	100.6	† 101.5	100.9	100.8	100.5	100.6	100.9	‡ 100.4	100.9	101.4	100.9
44	100.7	† 100.8	100.6	† 100.8	‡ 100.3	‡ 100.0	† 101.3	† 101.3	100.7	100.4	100.1	100.7	101.0	101.0	101.0
72	† 102.7	‡ 101.0	101.5	102.2	101.1	‡ 101.2	102.3	101.9	101.4	101.8	101.9	‡ 101.2	101.9	† 102.6	102.5
73	100.8	101.6	101.6	† 101.9	‡ 100.4	101.0	101.3	101.2	‡ 100.5	101.1	‡ 100.5	101.2	† 102.2	† 102.2	102.1
74	101.7	101.3	‡ 100.4	101.5	† 102.0	‡ 100.0	101.3	100.5	101.9	101.6	101.5	101.5	† 102.0	100.2	101.2
75	100.7	‡ 100.3	† 101.4	† 101.4	101.0	101.8	102.1	† 102.3	101.4	‡ 100.6	101.9	101.9	101.6	101.9	101.1
76	‡ 101.5	† 102.1	101.8	† 102.1	† 102.1	101.4	† 102.1	101.4	101.8	101.6	102.0	101.8	‡ 101.2	102.0	102.0
68	101.2	† 101.4	‡ 100.7	‡ 100.7	101.0	101.0	100.7	101.0	101.0	‡ 100.6	101.3	† 101.4	101.3	101.0	101.0
69	† 103.1	102.7	‡ 102.2	102.6	† 103.1	‡ 101.4	102.2	† 102.6	101.9	101.7	101.7	101.8	102.3	102.2	102.2
67	† 103.6	102.4	102.4	102.7	‡ 101.6	101.6	102.3	102.3	101.6	‡ 100.7	100.8	101.2	† 102.4	101.8	102.1
77	102.0	† 103.2	101.9	102.9	‡ 101.8	101.9	102.5	102.0	102.4	102.5	† 102.8	102.4	102.7	102.1	‡ 101.8
78	101.7	‡ 98.5	† 102.4	102.1	101.8	101.6	101.6	101.6	† 102.3	† 102.3	102.2	102.1	101.7	‡ 101.5	‡ 101.5
79	‡ 101.0	102.3	101.4	102.0	† 103.1	‡ 101.4	101.8	101.3	102.1	101.6	102.2	102.0	† 102.7	102.4	101.6
80	‡ 100.8	101.4	† 102.8	101.9	† 102.8	‡ 100.0	† 103.0	102.8	102.6	101.8	101.7	101.8	102.7	102.0	101.8

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* Test applied by E. A. A. Grange, V. S.

TABLE VII.*

No. of animal.	Temperatures before injection.					Temperatures after injection.										
	April 20, 1897.					April 21, 1897.										
	8:30 a. m.	10:30 a. m.	2 p. m.	4 p. m.	8:30 p. m.	6 a. m.	7:30 a. m.	8:30 a. m.	9:15 a. m.	10 a. m.	10:30 a. m.	1 p. m.	2 p. m	3 p. m.	4 p. m.	5 p. m.
81	‡ 101.3	† 102.0	101.9	101.4	101.9	101.5	102.1	--------	† 102.3	101.4	101.3	‡ 101.0	101.7	102.0	102.0	102.0
82	102.5	101.9	‡ 101.4	† 103.1	101.7	‡ 101.0	101.7	--------	101.7	101.6	101.8	101.9	101.4	101.9	102.5	† 102.7
29	100.8	100.8	† 101.2	101.0	‡ 100.6	101.0	100.6	100.6	100.5	100.9	--------	100.4	101.0	100.6	† 101.1	‡ 100.2
+32	† 102.2	101.7	100.4	‡ 100.1	100.4	101.2	‡ 100.7	100.8	101.4	102.6	--------	105.4	† 106.0	103.7	† 106.0	104.4
+26	‡ 100.8	101.0	101.3	‡ 100.8	† 101.6	‡ 102.8	103.9	105.4	106.7	106.3	--------	105.4	† 107.2	107.1	106.3	105.4
7	100.7	100.5	‡ 100.4	† 101.1	100.8	100.6	† 101.5	† 101.5	101.0	100.9	--------	101.1	100.8	‡ 100.4	100.8	101.2
11	† 101.6	101.2	101.3	101.0	‡ 100.8	† 101.6	101.3	‡ 100.6	101.5	101.1	--------	101.3	101.2	101.0	101.4	101.0
12	† 102.0	100.8	100.6	100.8	‡ 100.4	101.2	100.7	‡ 100.3	100.8	101.2	--------	100.4	101.1	101.1	† 101.6	101.5
13	† 101.5	‡ 100.9	101.5	101.1	101.2	101.5	† 102.1	101.5	101.3	102.0	--------	101.2	101.3	‡ 101.0	101.3	101.8
20	‡ 101.0	101.1	‡ 101.0	† 101.8	101.1	100.6	101.1	† 101.6	101.1	101.1	--------	100.4	100.6	‡ 100.0	100.8	101.4
17	101.2	‡ 100.0	† 101.4	† 101.4	100.8	101.0	100.8	101.2	† 101.5	101.0	--------	100.8	‡ 100.6	100.9	101.2	101.0
16	† 101.2	101.0	100.6	100.5	‡ 100.0	100.1	100.6	100.8	100.0	‡ 99.5	--------	101.1	101.0	† 101.3	101.1	100.5
+21	101.2	† 101.5	100.9	100.9	‡ 100.6	‡ 100.7	101.0	101.4	102.0	102.1	--------	103.7	103.5	103.0	† 103.8	103.4
23	100.9	† 101.0	‡ 100.5	100.9	100.6	† 101.2	100.6	† 101.2	† 101.2	100.9	--------	101.1	‡ 100.5	100.8	100.6	100.9
18	‡ 100.9	101.3	† 101.5	101.1	† 101.5	100.8	100.4	100.8	101.2	† 101.4	--------	101.2	100.4	‡ 100.0	100.5	100.5
9	‡ 100.7	101.0	100.9	101.0	† 101.2	100.5	100.9	‡ 100.0	100.3	100.4	--------	101.3	101.1	† 101.5	101.0	101.4
+ 4	† 101.5	101.2	100.8	‡ 100.6	101.0	101.4	101.6	‡ 101.3	102.1	103.9	--------	106.1	105.4	† 106.1	105.3	104.2
65	101.6	‡ 100.4	101.7	† 102.5	102.0	‡ 100.2	101.2	101.4	101.3	† 101.6	--------	100.4	100.7	100.8	101.4	100.6
64	‡ 100.6	101.9	† 102.2	101.4	100.9	100.4	† 102.2	101.2	100.5	101.3	--------	‡ 99.9	100.0	101.4	101.5	102.1
63	100.9	† 102.3	101.4	101.1	‡ 100.6	100.5	100.1	100.6	100.4	† 100.7	--------	100.5	100.6	100.5	† 100.7	‡ 100.1
34	† 102.0	‡ 100.6	101.4	101.0	101.3	‡ 101.3	101.2	102.2	101.5	103.2	--------	† 103.5	103.2	103.4	102.8	103.0
15	† 102.4	101.8	102.3	† 102.4	‡ 101.5	101.4	‡ 101.2	† 101.9	101.6	101.6	--------	101.8	101.6	101.6	101.8	† 101.9
45	101.4	101.4	102.0	† 102.2	‡ 100.6	100.9	‡ 100.3	100.8	100.4	101.0	--------	101.0	101.2	101.4	101.2	† 101.9

	June 9, 1897.					June 10, 1897.										
	8:30 a. m.	11 a. m.	2:30 p. m.	5 p. m.	8 p. m.	4:15 a. m.	5 a. m.	6 a. m.	7 a. m.	9:30 a. m.	10:30 a. m.	11:45 a. m.	1:15 p. m.	2:30 p. m.	4 p. m.	5 p. m.
84	102.0	‡ 101.3	† 102.2	101.4	101.8	101.4	101.6	‡ 100.8	101.6	101.8	† 101.0	102.1	102.3	101.6	101.0	101.2
85	‡ 100.8	100.9	101.6	101.7	† 101.9	101.2	‡ 101.0	‡ 101.0	101.3	102.0	101.4	101.8	101.8	101.8	† 102.2	101.5

	August 5, 1897.					August 6, 1897.												
	8 a. m.	10 a. m.	2 p. m.	5:10 p. m.	8:20 p. m.	4:15 a. m.	5:15 a. m.	6:15 a. m.	7:15 a. m.	8:45 a. m.	9:45 a. m.	11 a. m.	12 n.	1:15 p. m.	3:15 p. m.	4:15 p. m.	5:15 p. m.	6:50 p. m.
85	‡ 97.2	97.9	100.2	100.1	† 101.0	100.0	100.8	99.8	‡ 99.3	100.6	† 102.0	01.8	101.4	101.5	101.4	101.3	101.1	100.7

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* Test applied by E. A. A. Grange, V. S.

TABLE VIII.*

No. of animal.	Temperatures before injection.					Temperatures after injection.								
	April 22, 1897.					April 23, 1897.								
	9:30 a. m.	10:30 a. m.	2 p. m.	4 p. m.	8:30 p. m.	6 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	4 p. m.	5 p. m.
+10	† 101.5	101.1	‡ 101.0	101.3	101.4	‡ 101.0	101.2	101.2	101.9	101.1	101.4	† 104.6	103.2	102.8
+41	100.4	100.8	‡ 99.1	100.2	† 10 .4	101.6	101.6	102.0	101.3	‡ 100.8	102.8	† 105.0	103.1	101.0
+31	‡ 99.6	† 101.4	100.7	99.8	100.4	‡ 103.0	‡ 103.0	104.6	† 105.5	105.1	103.4	‡ 103.0	‡ 103.0	‡ 103.0
+83	† 102.4	101.5	101.3	‡ 101.2	100.4	‡ 103.2	105.0	† 105.4	105.2	104.8	105.2	105.0	105.0	103.6
+24	101.3	† 101.7	100.6	100.9	‡ 100.5	101.6	102.1	102.4	† 102.9	101.8	‡ 101.0	101.2	102.2	102.0
+22	† 101.8	100.7	101.4	100.9	‡ 100.1	101.5	101.5	101.2	‡ 100.4	100.6	100.6	100.6	† 101.6	101.0
+33	† 101.6	100.8	† 101.6	101.0	‡ 1 0.6	105.2	‡ 104.0	105.4	† 105.9	105.7	104.8	104.8	105.0	104.8
+30	‡ 100.0	100.7	101.1	100.4	† 101.2	101.0	‡ 100.0	101.6	101.3	102.4	104.6	104.4	† 104.8	104.0
+49	† 102.4	‡ 100.5	101.0	101.3	100.6	101.0	100.5	‡ 100.4	100.9	101.4	† 101.8	101.6	101.4	101.2
+38	100.7	† 101.2	100.8	100.9	‡ 100.6	100.2	100.5	101.0	100.8	100.6	100.6	† 101.2	† 101.2	‡ 100.1
+42	‡ 101.0	101.5	101.4	102.2	† 102.6	102.0	‡ 101.0	‡ 101.0	101.5	102.0	† 102.4	† 102.4	101.6	101.2

TABLE IX.

No. of animal.	Normal temperatures.									Normal temperatures.									
	September 3, 1897.									September 4, 1897.									
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 a. m	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
86	‡ 101.6	† 103.0	102.3	102.5	102.6	101.7	101.7	102.1	102.8	101.5	101.6	101.8	101.6	101.6	101.0	101.5	‡ 100.4	102.1	† 102.6
87	101.6	101.6	‡ 101.0	101.5	101.7	102.2	102.1	† 102.6	† 102.6	‡ 101.0	101.5	101.6	101.5	101.7	‡ 101.0	101.6	101.6	101.6	† 101.8
88	101.2	101.4	‡ 101.0	101.4	101.4	101.7	101.5	† 101.9	101.6	† 101.7	‡ 101.0	101.4	101.1	101.6	101.2	101.1	101.4	101.1	101.5
89	101.1	101.1	102.0	‡ 100.1	101.3	† 102.3	102.0	101.6	101.9	‡ 100.4	100.9	100.5	100.9	101.3	101.0	100.9	101.3	101.4	† 101.8
90	100.8	100.7	100.6	100.3	‡ 100.2	100.4	100.4	100.7	† 101.1	100.6	100.6	100.5	‡ 99.9	100.7	100.5	100.2	100.3	100.3	† 100.9
91	101.3	101.2	‡ 101.1	101.3	101.5	101.6	101.7	102.1	† 102.6	101.5	101.1	101.5	‡ 101.0	101.8	101.0	101.2	101.5	† 102.2	† 102.2
92	101.5	‡ 101.3	101.4	101.5	101.6	101.4	101.7	† 101.9	† 101.9	† 101.8	101.6	101.6	101.1	101.2	‡ 100.4	100.9	‡ 100.4	† 101.8	† 101.8
93	101.1	100.9	† 102.3	‡ 100.7	100.8	101.2	101.2	101.4	101.6	† 101.5	101.1	101.4	101.4	101.4	‡ 100.7	101.1	101.0	101.0	101.4
94	101.6	101.4	‡ 101.3	101.5	101.8	102.2	† 102.5	101.6	101.7	101.8	101.7	‡ 101.6	101.9	102.1	102.0	102.5	102.6	102.4	† 103.3
95	† 102.0	101.7	101.5	101.5	‡ 101.2	101 6	101.3	101.6	† 102.0	101.1	101.7	101.6	101.7	† 101.9	‡ 100.8	101.4	100.9	101.0	101.2
96	101.3	† 102.2	‡ 10 .8	100.9	101.0	101.5	101.3	101.8	102.0	101.4	101.3	101.2	101.4	† 102.9	101.4	101.0	‡ 100.9	101.4	101.7
97	102.4	103.4	‡ 102.0	102.1	102.4	103.6	102.9	† 103.8	103.0	102.2	‡ 102.1	102.6	102.4	103.2	102.7	103.0	† 103.6	102.4	102.6
98	101.0	101.3	101.2	† 102.1	‡ 100.8	101.7	1 1.5	101.3	101.2	101.3	101.2	101.3	101.0	† 102.1	‡ 100.2	100.9	101.4	100.7	101.0
99	102.2	101.0	‡ 100.6	† 102.8	100.9	101.9	101.7	102.1	102.1	101.6	101.9	101.9	101.6	† 102.0	‡ 101.2	101.9	101.9	101.9	† 102.0
100	† 102.4	‡ 101.3	101.7	102.2	102.1	102.0	101.9	101.9	102.0	101.3	101.2	101.5	102.2	† 102.3	101.5	101.2	101.5	101.6	‡ 101.1

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* Test applied by E. A. A. Grange, V. S.

TABLE X.

No. of animal.*	Am't in-jected.	Temperature before injection.								Temperature after injection.												
		September 6, 1897.								September 7, 1897.												
		9 a. m	10 a. m.	11 a. m	1 p. m.	2 p m	3 p. m	4 p. m	5 p m.	5 a. m	6 a. m	7 a. m.	8 a. m.	9 a. m.	10 a. m	11 a. m	12 n.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
86	2 c. c.	101.2	‡100.6	100.8	‡100.6	101.3	101.6	101.4	†102.0	100.8	100.8	100.6	100.5	100.5	100.6	‡100.4	100.8	101.0	100.8	101.2	101.7	†101.9
87	"	101.1	‡100.4	100.7	101.2	101.7	101.9	102.0	†102.5	100.7	100.5	‡100.4	100.9	100.6	100.6	100.8	101.0	100.9	101.8	101.3	102.0	†102.3
88	"	100.8	100.8	‡100.7	101.0	100.9	101.3	101.9	†102.3	100.4	101.2	‡100.2	100.8	101.0	100.9	100.6	101.3	101.1	101.7	102.0	101.9	†102.7
89	"	‡100.5	‡100.5	‡100.5	101.0	101.4	101.1	101.9	†102.4	101.1	101.0	100.5	101.0	100.8	‡100.4	100.6	‡100.4	101.0	101.1	101.2	101.4	†102.3
90	"	‡100.1	100.3	100.2	100.6	100.8	100.8	101.7	†102.2	‡100.0	100.9	‡100.0	100.7	100.5	100.7	100.7	100.5	100.7	100.7	101.1	100.8	†101.2
91	"	‡100.2	101.2	101.0	101.4	101.6	102.3	†102.4	101.3	‡100.1	100.7	100.5	100.5	100.8	100.6	101.2	101.4	100.6	101.7	101.3	101.8	†102.6
92	"	‡100.6	‡100.6	100.7	100.9	101.5	101.4	102.0	†102.1	‡100.3	101.0	100.6	100.9	100.8	100.7	101.1	101.3	100.8	101.4	101.6	100.9	†102.2
93	"	‡100.6	101.1	101.1	101.6	101.6	†102.1	101.6	101.6	‡100.6	‡100.6	100.8	100.8	101.1	100.7	101.1	100.9	101.0	†101.5	101.4	101.3	101.4
94	"	100.8	‡100.7	101.0	101.3	101.1	102.2	†102.6	102.5	‡101.0	101.5	101.9	101.4	101.3	101.2	101.7	102.2	101.7	102.5	102.9	102.5	†103.0
95	"	100.7	‡100.0	100.9	101.0	101.5	101.6	101.5	†102.4	‡100.2	100.4	100.8	100.7	100.6	100.4	101.1	100.9	100.5	101.4	100.9	†101.7	101.5
96	"	101.9	‡100.7	100.9	101.5	101.9	102.1	†102.2	†102.2	‡100.8	101.3	101.3	101.1	101.3	101.0	101.1	101.1	101.1	101.7	101.6	101.6	†101.8
97	"	‡101.7	101.9	101.9	101.8	†103.4	103.1	103.1	†103.4	‡100.6	102.1	101.1	101.8	101.5	101.0	102.0	102.3	102.0	102.6	102.6	†102.9	102.6
98	"	‡100.4	100.5	100.8	101.0	101.2	101.5	101.6	†102.4	100.5	100.4	101.3	101.2	100.9	‡100.3	100.7	101.2	101.3	101.5	101.3	101.5	†101.7
99	"	‡100.1	100.5	100.8	101.2	101.8	102.2	102.0	†102.7	‡100.4	100.6	101.1	100.6	100.8	100.8	101.3	100.8	101.1	102.2	†102.3	102.2	†102.3
100	"	101.1	‡100.7	101.3	101.6	101.8	101.9	101.4	†102.4	100.8	‡100.2	101.5	101.2	100.9	101.0	101.7	101.3	101.7	101.6	†101.9	†101.9	101.7

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* Injection made at 8 p. m , September 6, 1897.

TABLE XI.

No. of animal.	Normal temperatures.									Normal temperatures.								
	October 12, 1897.									October 13, 1897.								
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
9	‡ 99.8	100.3	100.7	100.7	100.9	101.2	101.2	† 101.4	100.6	‡ 100.1	100.4	100.6	100.2	100.5	† 101.4	100.8	100.3	100.8
7	100.7	100.9	‡ 100.2	101.0	101.1	101.1	† 101.3	101.2	† 101.3	‡ 99.3	100.2	100.6	101.2	100.8	101.4	101.3	101.1	† 101.6
13	† 101.2	100.6	100.6	‡ 100.4	101.1	100.6	100.9	100.8	101.1	† 101.1	100.3	100.2	99.9	100.4	100.7	100.4	‡ 99.7	99.8
14	† 102.2	‡ 101.2	101.3	101.3	101.5	101.5	101.7	101.7	101.8	‡ 100.8	101.1	100.9	101.2	101.0	101.5	101.4	101.1	† 101.7
17	100.3	100.1	100.3	‡ 100.0	100.7	100.5	100.6	† 100.8	100.5	‡ 99.8	100.3	100.2	100.4	† 100.8	100.4	100.5	100.4	† 100.8
16	100.7	101.0	100.4	100.4	‡ 100.1	101.0	101.5	† 101.6	101.4	† 101.5	100.5	‡ 100.1	100.8	100.3	101.0	† 101.5	† 101.5	101.2
2	101.3	‡ 100.6	101.3	101.2	101.7	102.1	102.1	† 102.4	102.1	102.0	101.4	‡ 100.8	101.1	101.2	101.7	† 102.2	101.7	101.6
23	100.6	100.8	‡ 99.2	101.0	100.1	100.3	100.9	† 101.1	100.9	100.8	100.2	‡ [illegible]	100.4	100.6	100.6	† 101.3	100.7	100.6
59	† 101.7	101.3	101.4	‡ 100.7	‡ 100.7	101.1	101.0	101.1	‡ 100.7	101.3	100.6	101.2	‡ 100.3	101.0	100.6	101.4	101.0	† 101.5
52	101.5	101.4	101.0	‡ 100.8	101.5	101.1	101.6	101.4	† 102.3	101.1	100.8	‡ 100.2	100.7	99.9	100.8	101.3	† 101.6	101.3
53	101.2	‡ 100.2	100.6	100.7	100.4	† 101.5	101.3	101.1	101.4	‡ 100.8	101.2	100.9	100.9	101.1	101.0	101.5	† 101.7	101.6
75	101.0	101.0	‡ 100.2	100.8	100.4	100.5	100.9	101.0	† 101.3	100.4	‡ 99.7	100.2	100.0	‡ 99.7	100.4	100.5	† 100.7	101.4
5	101.3	101.4	101.3	‡ 100.8	101.4	101.3	† 101.8	† 101.8	† 101.8	101.1	100.0	‡ 99.6	100.8	101.0	100.5	† 101.3	100.4	100.9
109	‡ 99.3	100.0	100.3	100.1	100.9	† 101.0	100.6	100.9	100.6	100.2	100.3	100.1	100.3	100.4	‡ 100.0	† 101.3	101.0	100.4
111	101.1	100.5	‡ 100.4	‡ 100.4	† 101.5	101.2	101.1	101.4	101.2	100.3	100.7	100.4	100.6	100.2	‡ 100.1	101.6	101.7	† 102.3
110	101.1	101.2	‡ 100.9	101.0	101.1	101.3	‡ 100.9	† 102.4	102.0	101.3	† 101.7	101.0	‡ 100.6	† 101.7	100.8	101.4	101.6	101.4
107	101.3	101.1	101.2	101.2	101.1	101.0	101.3	‡ 100.3	† 101.4	100.3	‡ 99.7	100.8	100.1	100.8	† 101.0	† 101.0	100.9	100.7
108	100.7	‡ 100.0	‡ 100.0	‡ 100.0	100.3	101.0	100.5	† 101.1	100.8	101.3	99.8	100.0	101.0	‡ 99.7	99.8	101.0	100.5	† 101.4
101	† 101.1	‡ 99.5	‡ 99.5	100.7	100.7	100.4	100.0	100.5	100.2	100.6	100.5	† 100.9	100.4	100.6	100.1	100.2	‡ 99.7	100.5
103	† 101.7	101.3	101.5	101.4	‡ 100.0	101.0	101.4	100.7	100.5	† 101.4	101.1	100.0	‡ 99.8	100.6	100.2	101.1	101.3	100.4
106	101.4	101.1	100.9	‡ 100.7	† 101.8	100.9	101.1	101.1	101.4	101.0	100.8	101.4	‡ 100.2	101.2	101.0	101.9	101.7	† 102.4
104	† 101.4	100.8	100.4	‡ 100.1	100.9	100.8	100.7	100.6	100.9	100.0	100.6	100.1	99.9	‡ 99.2	100.6	100.7	† 101.3	100.9
105	† 101.3	100.9	‡ 100.0	101.0	100.7	101.1	100.6	100.8	101.0	† 101.2	‡ 100.1	100.9	100.2	100.3	100.3	100.8	100.6	‡ 100.1
112	‡ 100.0	100.5	100.7	100.5	101.2	101.4	† 102.3	101.0	101.6	‡ 98.5	100.0	99.0	100.2	100.7	101.0	100.3	† 101.8	101.0
113	‡ 100.5	101.9	100.8	102.2	† 102.8	102.4	102.6	102.0	102.4	‡ 93.4	100.4	101.1	101.9	101.4	101.9	102.1	102.6	† 102.9
114	100.8	101.8	101.7	‡ 100.5	101.0	102.0	† 103.0	101.0	101.9	‡ 99.3	99.4	100.1	100.6	101.4	101.2	101.6	† 101.9	101.0
115	‡ 100.8	102.0	101.1	101.4	102.1	† 103.3	102.7	101.6	101.7	‡ 99.4	100.0	100.6	101.1	100.8	101.2	† 102.6	101.8	102.3
44	100.1	100.0	‡ 99.3	100.1	100.1	100.5	100.7	† 101.3	100.7	98.6	97.8	‡ 97.1	97.8	98.2	99.0	99.1	100.0	† 100.3

TABLE XII.

No. of animal.	Am't injected.	Temperatures before injection.									Temperatures after injection.										
		October 13, 1897.									October 14, 1897.										
		8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	5 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
*9	2 c. c.	‡100.1	100.4	100.6	100.2	100.5	†101.4	100.8	100.3	100.8	100.6	101.2	100.7	‡100.1	100.6	101.0	101.1	101.2	101.2	101.4	† 102.0
+7	"	‡ 99.3	100.2	100.6	101.2	100.8	101.4	101.3	101.1	†101.6	‡101.4	101.9	103.2	103.0	104.4	†104.6	103.1	101.8	‡101.4	‡101.4	102.0
13	"	†101.1	100.3	100.2	99.9	100.4	100.7	100.4	‡ 99.7	99.8	100.6	100.4	100.5	100.6	100.5	101.3	100.9	101.3	‡100.0	101.1	† 101.6
14	"	‡100.8	101.1	100.9	101.2	101.0	101.5	101.4	101.1	†101.7	101.0	101.0	101.4	‡100.8	101.3	101.5	101.4	101.8	102.0	101.7	† 102.6
17	"	‡ 99.8	100.3	100.2	100.4	†100.8	100.4	100.5	100.4	†100.8	‡100.3	100.8	100.7	100.6	100.5	100.7	100.6	100.8	100.7	†101.4	† 101.4
16	"	†101.5	100.5	‡100.1	100.8	100.3	101.0	†101.5	†101.5	101.2	‡100.3	100.7	100.5	100.6	100.7	100.5	100.8	101.3	101.9	101.7	† 102.4
2	"	102.0	101.4	‡100.8	101.1	101.2	101.7	†102.2	101.7	101.6	101.8	‡101.2	101.6	101.3	101.4	101.6	101.9	102.1	102.2	102.7	† 103.2
23	"	100.8	100.2	‡100.1	100.4	100.6	100.6	†101.3	100.7	100.6	‡100.2	100.4	100.4	100.3	‡100.2	100.4	100.4	100.7	101.3	101.1	† 102.0
59	"	101.3	100.6	101.2	‡100.3	101.0	100.6	101.4	101.0	†101.5	101.0	101.4	101.8	101.0	101.0	‡100.9	‡100.9	101.1	101.2	101.5	† 102.0
52	"	101.1	100.8	100.2	100.7	‡ 99.9	100.8	101.3	†101.6	101.3	100.9	101.0	101.6	101.0	‡100.5	101.0	101.3	101.5	101.3	101.7	† 102.4
53	"	‡100.8	101.2	100.9	100.9	101.1	101.0	101.5	†101.7	101.6	101.1	101.4	101.4	100.7	‡100.5	101.4	101.1	101.6	101.4	101.5	† 102.6
75	"	100.4	‡ 99.7	100.2	100.0	‡ 99.7	100.4	101.5	100.7	†101.4	101.3	101.3	101.0	‡ 99.8	100.0	100.2	100.6	101.3	†101.6	101.2	101.0
+5	"	101.1	100.0	‡ 99.6	100.8	101.0	100.5	†101.3	100.4	100.9	103.2	103.0	103.2	102.9	103.0	†104.4	104.1	103.8	102.8	‡102.6	103.1
109	"	100.2	100.3	100.1	100.2	100.4	‡100.0	†101.3	101.0	100.4	100.4	101.2	†101.7	100.6	‡100.3	101.0	100.4	101.3	100.9	101.5	101.3
111	"	100.3	100.7	100.4	100.6	101.2	‡100.1	101.6	101.7	†102.3	102.0	101.4	101.8	101.4	101.2	‡101.0	102.0	102.7	102.4	102.9	† 103.0
110	"	101.3	†101.7	101.0	‡100.6	†101.7	100.8	101.4	101.6	101.4	101.8	102.1	102.3	‡101.4	101.5	101.8	102.1	102.7	102.0	102.9	† 103.0
107	"	100.5	‡ 99.7	100.8	100.1	100.8	†101.0	†101.0	100.9	100.7	‡100.7	101.2	101.2	101.4	101.9	101.2	101.0	101.7	102.1	102.5	† 103.2
108	"	101.3	99.8	100.0	101.0	‡ 99.7	99.8	101.0	100.5	†101.4	‡100.4	101.3	101.0	101.4	100.8	100.7	101.2	101.5	101.5	†101.8	101.6
101	"	100.6	100.5	†100.9	100.4	100.6	100.1	100.2	‡ 99.7	100.5	100.8	101.2	101.0	101.0	100.8	100.2	‡100.0	100.9	100.4	100.4	† 101.3
103	"	†101.4	101.1	100.0	‡ 99.8	100.6	100.2	101.1	101.3	100.4	100.5	101.1	101.1	‡100.4	100.6	‡100.4	100.5	101.3	101.6	101.8	† 102.1
106	"	101.0	100.8	101.4	‡100.2	101.2	101.0	101.0	101.7	†102.4	101.3	101.5	101.5	101.0	‡100.8	101.1	101.3	101.6	102.6	102.1	† 102.7
104	"	100.0	100.6	100.1	99.9	‡ 99.2	100.6	100.7	†101.3	100.9	100.3	100.7	100.4	100.7	100.4	100.3	100.1	‡100.0	†101.2	†101.2	† 101.2
105	"	†101.2	‡100.1	100.9	100.2	100.3	100.3	100.8	100.6	‡100.1	101.0	101.6	101.2	101.6	‡100.6	101.0	101.1	101.0	101.5	102.0	† 102.1
112	1 c. c.	‡ 98.5	100.0	99.0	100.2	100.7	101.0	100.3	†101.8	101.0	‡ 99.8	101.4	101.4	101.4	101.5	102.0	102.0	102.6	102.3	†103.6	103.4
113	"	‡ 99.4	100.4	101.1	101.9	101.4	101.9	102.1	102.6	†102.9	‡101.7	102.1	101.8	102.0	103.0	102.8	103.3	103.6	104.1	†104.4	103.8
114	"	‡ 99.3	99.4	100.1	100.6	101.4	101.2	101.6	†101.9	101.0	‡100.3	101.3	101.9	101.4	101.6	102.2	102.1	103.2	102.6	103.5	† 103.6
115	"	‡ 99.4	100.0	100.6	101.1	100.8	101.2	†102.6	101.8	102.3	102.5	‡102.0	102.1	‡102.0	‡102.0	102.6	102.5	103.2	†103.6	103.4	† 103.6
44	2 c. c.	98.6	97.8	‡ 97.1	97.8	98.2	99.0	99.1	100.0	†100.3	100.0	‡ 99.8	101.0	99.9	100.4	100.2	100.8	101.1	100.4	101.3	† 101.6

* Injection made at 8 p. m., October 13, 1897.

TABLE XIII.

No. of animal.	Am't in-jected.	Temperatures before injection.							Temperatures after injection.											
		October 13, 1897.							October 14, 1897.											
		9 a. m.	10 a. m.	11 a. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	5 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
*+4	2 c. c.	‡ 99.2	101.1	101.7	† 101.9	101.5	101.8	100.9	† 102.7	100.9	102.0	101.2	101.1	‡ 100.8	102.3	101.6	102.0	102.4	101.8
+10	"	‡ 100.5	101.6	101.3	100.8	101.7	101.3	† 102.2	101.2	101.2	101.4	‡ 101.1	‡ 101.1	101.4	102.0	101.8	101.5	102.0	† 102.3
+21	"	101.7	‡ 100.5	102.2	102.6	103.0	† 103.3	† 103.3	102.3	103.3	‡ 102.2	103.1	103.2	103.1	103.0	104.1	104.2	† 104.6	103.7
+24	"	102.2	102.5	102.5	102.5	† 102.8	101.9	‡ 101.3	‡ 100.4	101.7	101.8	101.3	100.6	100.9	101.2	101.5	101.6	101.5	† 102.2
+22	"	† 101.6	99.9	‡ 100.9	101.2	101.4	101.0	101.4	100.6	100.3	99 9	99.9	‡ 99.8	100.4	101.0	100.8	101.0	† 101.9	101.7
+33	"	‡ 99.9	100.3	† 102.2	100.9	101.3	102.0	99.5	102.4	102.4	102.5	103.0	103.2	103.9	† 104.4	103.6	103.1	102.6	‡ 101.7
+30	"	101.6	‡ 100.9	101.7	101.5	102.0	† 102.2	101.6	103.1	‡ 101.9	102.4	103.3	104.0	104.5	105.3	† 105.8	105.6	† 105.8	105.1
+49	"	101.5	‡ 100.5	102.1	† 102.6	† 102.6	101.8	103.0	105.2	104.9	104.9	105.5	105.7	105.7	† 105.9	105.4	105.0	‡ 104.0	104.1
+32	"	101.6	‡ 99.9	101.6	† 102.5	102.3	102.0	101.6	104.2	104.0	‡ 103.7	105.2	105.3	† 105.6	105.4	104.9	104.6	105.0	104.4
+26	"	† 100.7	100.6	100.1	‡ 100.0	100.2	100.4	100.3	101.6	‡ 101.3	102.8	105.5	† 106.1	105.6	104.7	105.4	105.7	105.9	105.7
+83	"	98.8	‡ 99.5	102.0	101.5	† 102.2	101.4	101.4	† 106.2	104.4	104.9	105.1	105.6	104.9	105.1	105.6	105.0	104.8	‡ 104.1
+42	"	99.6	‡ 99.4	† 101.9	101.6	101.8	101.3	100.5	104.4	105.2	105.2	105.4	105.7	† 105.8	105.2	104.7	104.4	104.0	‡ 102.5
+37	"	‡ 100.8	101.2	101.8	101.8	101.7	† 102.0	101.2	‡ 100.8	101.7	101.8	101.4	101.3	100.9	102.3	102.8	102.1	† 103.0	102.5

* Injection made at 8 p. m., October 13, 1897.

TABLE XIV.

No. of animal.	Normal temperatures.									Normal temperatures.									
	March 28, 1898.									March 29, 1898.									
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
129	101.0	101.0	‡ 99.7	101.2	101.4	100.3	100.2	100.7	† 101.6	100.7	101.7	101.0	† 101.8	99.7	100.2	‡ 99.1	100.8	101.3	100.3
130	100.2	100.7	† 101.5	100.2	100.8	99.8	101.0	‡ 99.5	100.0	101.7	100.9	† 102.5	‡ 99.2	101.6	100.9	101.5	101.6	102.3	100.7
131	100.7	‡ 99.3	101.9	101.9	101.1	100.9	101.0	† 102.3	100.1	100.3	‡ 99.5	101.4	101.7	101.0	101.5	100.6	100.6	† 102.6	102.5
132	101.3	100.5	102.4	101.0	‡ 99.8	† 103.1	102.0	102.4	101.1	† 103.1	102.4	102.5	102.0	101.3	102.7	101.7	‡ 100.0	101.9	102.8
45	† 98.8	97.3	‡ 96.8	96.9	‡ 98.8	97.8	98.4	97.8	97.5	99.0	‡ 96.0	98.4	98.9	97.9	98.7	97.9	98.6	99.0	† 99.2
128	100.8	† 102.0	99.9	99.8	100.6	99.3	98.1	‡ 98.7	100.8	99.3	98.9	‡ 98.3	98.4	† 101.0	100.6	99.7	99.4	100.2	† 101.0
127	† 102.3	99.6	101.0	98.6	99.4	97.8	99.1	‡ 95.6	100.8	98.8	97.8	99.5	98.3	97.8	‡ 96.5	98.9	95.9	† 99.9	96.7
44	98.0	‡ 97.4	97.5	98.3	99.4	98.2	98.0	† 99.5	† 99.5	‡ 97.3	‡ 97.3	‡ 99.7	98.1	99.3	98.8	98.0	98.0	98.1	98.9
125	100.7	98.0	100.6	100.5	† 101.1	100.3	98.5	‡ 97.3	100.3	102.3	† 103.1	103.0	101.6	101.7	101.3	100.3	‡ 99.9	101.3	101.3
43	97.7	99.1	‡ 96.4	† 99.8	99.2	97.4	98.2	97.4	99.0	99.7	† 99.9	99.1	98.6	99.0	98.0	98.6	99.5	‡ 97.7	99.5
123	100.9	101.2	101.0	99.3	‡ 98.9	100.5	100.3	† 101.8	100.4	101.2	† 101.4	99.6	99.3	99.1	99.7	99.3	100.2	100.2	‡ 98.2
126	99.3	† 100.3	‡ 98.1	99.7	99.3	99.3	99.9	100.1	100.2	98.8	99.4	98.2	98.9	98.9	99.1	99.6	99.0	‡ 97.9	† 101.1
124	101.0	99.3	101.8	100.6	99.7	‡ 98.5	101.3	† 103.8	99.2	101.3	† 101.7	101.1	100.0	100.9	100.0	100.0	‡ 98.6	100.3	99.3
122	101.9	101.8	100.6	100.0	† 102.2	100.5	‡ 99.1	100.6	101.8	‡ 96.4	† 101.1	100.9	99.9	98.7	100.7	98.4	98.0	98.2	99.5
52	97.9	98.6	‡ 96.9	98.3	† 98.9	97.4	97.6	98.2	97.8	98.4	100.2	‡ 97.3	† 101.0	99.2	99.3	98.7	99.5	99.1	99.6
121	‡ 99.4	101.0	100.3	† 101.2	100.3	100.6	99.5	100.1	100.5	100.3	100.9	100.5	100.7	† 101.4	‡ 99.0	100.1	100.8	101.3	100.2
53	100.7	† 102.0	99.4	100.5	100.8	100.0	101.2	† 102.0	‡ 99.3	‡ 99.8	† 103.6	103.3	102.0	102.0	101.2	103.1	102.3	100.9	‡ 99.8
133	† 101.6	98.5	97.8	98.7	‡ 96.9	97.7	98.2	98.4	99.1	99.8	100.5	100.5	‡ 98.3	99.8	† 101.6	100.7	100.1	99.8	99.3
112	† 99.9	† 99.9	‡ 97.2	99.8	99.8	98.4	97.6	99.1	† 99.9	† 101.0	99.1	‡ 98.2	98.6	99.6	99.1	99.4	100.5	99.0	99.1
113	100.5	100.5	99.8	‡ 98.4	† 101.8	100.3	99.9	100.4	100.1	† 101.6	100.2	98.2	100.7	‡ 97.3	97.8	99.6	100.0	98.1	100.6
120	100.5	100.2	101.2	100.6	100.4	101.0	100.3	† 101.5	99.4	† 101.8	101.0	98.3	100.0	100.0	‡ 98.0	‡ 98.0	100.2	100.5	100.7
68	99.8	98.4	‡ 95.5	99.0	98.7	98.5	† 100.2	98.4	98.0	98.3	‡ 97.3	97.4	98.6	† 98.7	98.1	98.5	98.4	98.5	98.0
114	98.4	100.1	99.2	99.8	‡ 97.0	100.1	98.6	100.1	† 102.2	98.8	† 100.5	99.9	98.1	97.5	99.4	99.6	‡ 96.6	96.7	97.1
117	99.9	99.9	99.4	† 100.6	‡ 98.8	99.2	99.6	99.6	99.9	‡ 99.1	† 103.1	102.4	100.4	101.7	102.1	101.8	102.4	99.3	102.5
119	98.6	98.7	99.3	99.6	99.6	100.0	‡ 98.4	99.7	† 100.1	† 100.7	100.0	99.2	‡ 98.4	99.1	99.8	98.5	98.7	99.3	100.4
70	99.3	99.3	97.5	98.0	‡ 97.1	96.9	† 100.2	97.9	96.6	98.9	99.2	99.2	100.0	99.1	‡ 97.3	98.2	98.5	98.5	† 99.6
115	101.2	100.7	99.9	101.0	† 101.8	100.8	‡ 99.2	100.6	101.1	100.3	100.0	100.6	100.4	99.8	‡ 98.2	99.7	98.5	98.8	† 100.7
118	98.6	98.7	‡ 98.0	100.4	† 102.2	98.8	98.2	99.7	100.4	99.8	98.3	98.7	99.7	† 100.8	99.9	99.6	98.4	‡ 96.4	99.9

TABLE XV.

No. of animal.	Am't in-jected	Temperatures before injection.										Temperatures after injection.											
		March 31, 1898.										April 1, 1898.											
		7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	4 a. m.	5 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
*129	1 c. c.	101.7	101.2	100.6	101.0	101.3	101.0	‡100.4	100.7	†102.1	102.0	101.7	†101.9	100.6	100.4	100.7	101.4	100.5	‡100.1	100.9	101.0	101.0	‡100.1
130	"	‡99.9	100.2	101.1	101.8	100.6	101.2	100.3	101.6	†102.6	102.0	100.1	†101.7	100.1	99.9	100.6	101.2	97.7	100.4	101.5	100.1	101.5	‡99.6
131	"	101.1	100.9	‡98.8	100.0	101.6	101.2	101.6	100.0	†102.2	102.0	101.1	101.0	100.7	99.8	101.3	†101.6	100.1	100.0	‡99.1	100.2	100.8	101.1
132	"	102.0	100.8	‡99.7	100.3	100.2	100.0	†102.2	100.6	101.4	101.4	†102.9	100.8	101.1	102.5	102.5	101.1	100.3	‡98.5	98.7	99.3	102.9	102.5
127	"	‡96.6	98.1	100.3	100.8	100.0	101.4	†101.9	100.8	99.2	99.1	†100.6	98.7	98.0	99.0	100.0	99.5	100.1	†100.6	98.1	‡97.0	97.3	98.2
128	"	†102.3	101.0	99.9	100.1	99.6	99.0	‡98.1	98.8	100.1	99.5	99.9	99.1	100.3	98.5	98.0	†100.9	99.5	98.6	99.0	99.5	100.7	‡97.8
125	"	99.4	‡98.9	99.6	100.0	100.6	†101.2	100.8	100.8	100.5	100.4	99.4	100.7	99.9	99.2	‡99.1	100.8	99.9	100.2	100.9	99.2	†101.1	99.2
126	"	100.6	100.3	100.1	101.1	99.0	100.1	‡98.9	99.8	†101.3	99.7	99.2	99.2	101.0	100.4	100.6	100.9	‡97.5	99.8	99.5	100.1	100.0	†101.2
123	"	99.5	†101.7	99.7	99.0	99.4	‡98.5	98.9	100.1	99.9	100.4	98.8	100.6	101.3	†101.5	100.8	101.1	100.7	99.6	99.8	‡98.1	100.2	99.4
124	"	†100.7	100.3	99.3	100.0	98.5	99.8	99.7	100.1	98.8	‡98.3	99.5	99.9	99.3	100.6	98.5	100.3	‡98.4	†102.3	99.1	99.6	100.2	100.4
122	"	99.7	98.6	99.5	99.0	98.8	99.3	‡97.9	98.1	†101.2	99.8	98.7	99.7	97.3	98.7	99.1	98.7	99.5	†101.2	100.9	99.6	‡97.2	100.5
133	"	†102.3	99.6	102.0	102.2	100.2	101.4	97.9	97.3	98.5	‡97.7	99.4	100.4	99.4	98.1	100.5	99.8	†101.2	100.4	‡97.6	98.4	98.6	†101.2
121	"	†101.7	101.0	100.1	99.8	‡99.3	101.0	100.1	‡99.3	†101.7	100.8	100.2	100.8	99.1	‡98.7	100.5	98.8	99.7	100.3	100.6	99.3	100.1	†101.4
120	"	†100.9	‡99.0	100.3	‡99.0	100.8	100.7	100.1	100.0	99.9	99.7	99.2	100.5	100.1	100.5	99.7	†100.6	‡98.6	99.9	99.1	100.5	†100.6	100.4
112	"	100.0	‡97.8	100.4	100.2	100.2	101.3	99.2	†101.8	99.8	100.3	100.6	99.2	99.5	99.6	100.5	†101.7	100.2	101.3	101.0	‡98.5	101.4	101.0
113	"	99.6	‡98.5	98.7	99.2	99.5	100.1	99.3	†101.7	100.2	101.0	101.0	100.0	100.4	99.2	‡98.2	99.6	98.4	99.0	101.0	100.2	99.7	†101.3
114	"	‡97.6	98.9	99.0	†100.6	98.4	98.0	‡97.6	97.9	97.9	100.2	99.7	98.4	99.3	98.4	99.1	98.5	100.1	‡97.1	97.4	98.1	100.6	†100.7
115	"	‡99.2	100.2	†100.4	100.0	99.8	†100.4	99.7	99.9	99.3	100.2	†101.4	99.6	99.9	101.0	100.6	‡99.3	100.2	100.4	100.2	100.8	100.5	100.3
118	"	99.7	99.1	98.9	101.4	100.2	97.7	‡97.0	101.1	100.9	†101.5	98.4	100.1	100.2	99.3	†101.0	100.9	99.6	99.1	‡97.5	98.0	100.4	98.4
119	"	100.3	100.2	‡99.0	‡99.0	100.0	99.3	‡99.0	99.1	†100.6	100.8	99.1	98.8	98.6	101.2	99.5	98.7	‡98.3	99.3	100.0	99.2	†101.6	100.7
43	2 c. c.	98.9	100.8	‡98.9	†101.5	100.9	100.1	99.3	100.4	99.9	100.5	99.9	98.8	99.5	99.7	98.3	†100.6	100.3	99.9	100.5	99.4	‡98.0	100.2
44	"	97.9	‡96.8	98.9	98.1	98.6	97.5	99.7	†100.0	99.9	99.0	‡97.8	99.2	†100.7	98.8	99.1	98.5	100.1	99.0	99.2	99.3	100.1	99.0
45	"	97.7	97.4	98.7	98.8	97.9	‡96.6	99.8	98.1	98.3	†101.3	99.0	‡96.7	99.1	98.1	99.0	100.7	98.6	100.1	102.0	†102.1	†102.1	101.7
52	"	98.6	98.8	98.7	98.8	98.8	‡98.1	98.6	98.8	†99.9	99.2	99.3	99.6	99.6	100.0	†100.9	99.1	99.1	‡98.5	100.1	100.5	99.1	99.6
53	"	99.0	‡97.8	99.5	99.0	99.3	98.1	99.9	†100.6	99.5	99.4	‡97.1	99.4	98.9	98.5	99.2	99.8	99.8	98.3	98.8	†100.7	100.0	99.4
68	"	97.8	98.1	‡97.1	99.9	99.4	†100.2	99.9	99.7	99.4	100.0	97.6	‡97.1	99.9	†100.4	97.7	99.5	98.6	99.3	98.1	100.1	98.2	98.1
70	"	‡97.4	†101.6	100.7	98.4	98.5	99.1	99.2	98.0	99.8	100.5	98.5	101.7	†101.9	101.4	98.5	99.2	99.6	99.2	98.6	‡98.5	99.5	99.0
117	1 c. c.	†101.8	‡99.3	100.9	100.4	100.9	100.1	100.4	101.7	101.3	100.2	99.9	‡99.1	†101.4	100.4	101.3	100.7	†101.4	100.5	101.3	100.5	101.0	100.2
†136	"	†100.0	99.5	------	‡97.2	------	99.8	99.3	------	98.6	------	97.7	‡97.3	98.8	97.7	99.5	97.6	99.4	†101.4	98.1	100.5	99.4	------

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* Injection made 8 p. m. March 31.

† This animal was tested Jan. 14 and 15, 1898.

TABLE XVI.

No of animal.	Normal temperatures.									Normal temperatures									
	March 28, 1898.									March 29, 1898.									
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 a. m.	8 a. m.	9 a m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
14	99.9	98.1	† 100.2	93.7	‡ 96.7	97.2	97.4	99.0	98.0	99.0	† 100.0	97.4	97.3	98.0	97.0	97.9	97.1	97.9	‡ 96.3
13	100.4	† 100.7	‡ 99.0	100.0	99.4	99.4	99.9	99.8	99.8	98.9	100.4	100.5	‡ 98.5	99.5	101.7	101.4	101.0	† 102.0	99.3
15	100.7	100.1	‡ 99.2	† 101.2	99.9	99.3	100.7	99.9	99.5	100.9	101.0	100.4	100.9	99.7	‡ 98.4	99.4	99.1	100.6	† 102.0
11	100.2	100.7	† 100.9	100.5	‡ 98.4	99.5	100.2	100.2	99.4	† 101.3	100.5	99.6	99.5	93.5	100.6	‡ 98.2	100.1	99.0	100.0
9	† 100.7	100.1	98.8	99.8	93.0	‡ 97.4	97.9	98.9	99.6	† 100.2	99.2	99.5	99.8	97.7	‡ 97.5	98.0	98.8	99.0	100.1
6	† 103.4	101.7	104.2	102.4	102.5	103.9	102.8	102.8	‡ 101.6	100.1	100.6	99.9	† 100.7	99.5	98.8	99.1	99.8	‡ 98.4	100.0
29	† 100.7	100.2	99.6	‡ 99.2	99.9	99.9	99.7	99.6	99.7	99.5	99.8	99.4	† 100.6	93.7	99.1	‡ 98.2	99.5	99.3	99.8
57	† 102.3	101.5	101.2	101.8	‡ 97.4	98.4	100.1	101.0	102.0	100.9	† 101.7	100.2	101.4	99.7	101.0	100.0	99.9	‡ 99.3	99.8
56	99.8	† 101.5	100.1	100.4	‡ 98.2	99.8	99.0	99.4	100.5	100.1	99.7	100.0	99.7	99.5	99.8	† 100.5	100.0	100.2	‡ 98.4
63	† 100.7	100.2	† 100.7	99.9	‡ 97.9	100.1	99.9	100.0	99.2	100.8	100.8	99.8	100.2	‡ 98.6	99.1	100.2	100.2	99.9	† 101.0
20	† 102.3	101.3	99.6	99.6	100.0	‡ 93.3	99.7	99.6	99.8	99.9	99.4	† 100.5	98.8	99.1	‡ 93.7	† 100.5	99.8	100.2	100.2
17	99.2	100.0	† 100.6	99.9	99.2	99.2	‡ 98.7	100.2	98.8	103.0	103.4	† 104.2	103.7	103.3	† 104.2	104.1	102.8	103.6	‡ 101.9
16	† 101.3	99.8	99.9	101.1	99.4	‡ 99.3	93.8	100.3	99.7	† 99.6	‡ 98.3	98.9	† 99.6	99.3	99.4	† 99.6	99.3	† 99.6	99.4
2	† 100.8	93.8	99.8	99.3	93.3	99.3	‡ 93.2	98.8	98.7	† 100.7	99.4	99.8	99.3	100.4	‡ 98.9	100.1	99.2	99.4	‡ 93.9
23	101.1	100.8	100.9	† 102.0	99.2	99.7	99.8	100.2	‡ 99.1	100.5	99.7	† 101.9	‡ 99.2	100.4	101.0	100.8	100.2	101.6	101.0
+22	100.1	100.2	99.7	100.3	99.7	100.5	‡ 98.6	† 100.9	99.2	99.7	99.7	‡ 98.6	† 100.2	99.5	99.5	99.6	99.1	99.8	98.7
69	101.9	† 102.0	101.2	100.1	101.0	101.3	99.8	101.9	‡ 99.4	† 103.9	102.6	103.6	101.8	99.6	101.3	101.4	101.8	‡ 100.1	101.6
67	100.7	101.8	† 102.0	101.0	‡ 98.4	100.3	101.0	100.0	99.7	101.7	‡ 99.5	100.7	† 102.8	101.2	101.0	101.2	102.0	102.4	101.1
59	† 102.5	† 102.5	101.8	102.4	‡ 99.9	100.7	100.6	100.5	100.5	102.4	102.2	101.8	† 102.8	‡ 100.5	101.3	101.3	101.0	101.4	101.2
77	† 101.7	100.9	100.5	‡ 97.0	98.6	98.9	100.4	99.2	100.4	† 101.8	100.0	101.3	100.8	99.4	99.6	100.8	100.0	‡ 99.0	100.2
83	† 100.6	100.3	† 100.6	100.3	‡ 98.8	99.7	100.4	99.6	99.9	100.8	100.1	99.8	† 100.9	‡ 99.3	100.6	100.3	100.7	100.2	99.6
78	† 101.4	101.2	100.4	‡ 97.9	100.2	100.0	99.6	100.0	100.0	101.3	101.3	101.3	† 101.4	98.8	99.7	98.8	99.0	‡ 98.4	99.7
74	† 101.2	100.6	101.1	‡ 93.4	100.9	99.7	101.0	99.2	99.6	† 102.1	100.0	101.6	100.0	‡ 98.5	93.6	‡ 93.5	100.9	99.0	99.8
79	† 101.5	99.2	99.4	‡ 98.6	98.9	100.5	100.4	100.3	101.1	99.2	99.3	99.6	99.4	99.7	99.8	† 100.3	99.1	99.0	‡ 98.6
80	101.3	† 101.5	101.0	98.8	‡ 93.6	100.8	99.8	99.7	101.3	100.5	100.7	100.3	† 101.7	100.7	‡ 99.4	100.1	100.6	100.9	93.8
76	† 102.1	99.9	100.3	‡ 96.9	98.9	100.0	99.8	99.7	100.2	101.0	100.6	† 102.2	101.1	‡ 99.0	100.4	99.7	99.2	‡ 99.0	100.2
85	† [illegible]	‡ 99.2	100.0	99.6	100.4	99.9	100.0	100.8	99.7	100.5	100.7	100.9	100.2	‡ 97.3	99.3	98.7	† 101.0	100.3	100.9
72	† 102.0	100.7	99.6	‡ 97.9	93.9	98.2	99.7	100.9	100.3	‡ 96.9	† 101.0	99.7	99.0	93.4	99.0	99.6	99.5	98.2	100.0
75	† 101.9	100.7	100.3	‡ 97.9	100.0	100.0	99.8	100.6	100.5	99.6	† 100.9	99.8	† 100.9	‡ 99.0	99.6	100.2	100.0	100.6	100.1

TABLE XVII.

No. of animal.	Am't injected.	Temperatures before injection.										Temperatures after injection.											
		March 31, 1898.										April 1, 1898.											
		7 a. m.	8 a. m.	9 a. m	10 a. m.	11 a. m.	1 p. m.	2 p. m	3 p. m.	4 p. m.	5 p. m	3 a. m.	4 a. m.	5 a. m.	7 a. m	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.
*14	2 c. c.	98.8	†100.4	98.5	98.5	‡ 95.3	96.3	97.2	98.9	98.9	97.8	98.4	99.1	98.7	98.8	98.1	†100.3	99.1	97.6	98.4	97.0	98.4	‡ 96.9
13	"	†102.0	99.2	100.4	99.7	‡ 98.0	98.6	98.6	1[illegible]1.6	99.4	98.3	99.2	98.7	98.8	99.2	98.8	10[illegible].4	†100.5	97.6	98.6	99.2	99.0	‡ 97.3
15	"	100.5	99.9	100.2	†101.5	‡ 98.0	99.6	100.2	99.9	100.6	99.8	100.0	99.9	100.7	100.5	100.9	†101.0	100.5	‡ 99.0	100.2	99.8	99.9	100.0
11	"	99.8	99.0	99.6	†100.5	‡ 97.0	97.1	99.7	99.2	99.6	99.0	99.1	99.3	99.6	99.3	†100.4	99.8	99.4	‡ 97.0	98.1	98.5	98.8	98.2
9	"	99.6	† 99.9	‡ 98.2	99.0	98.4	98.4	99.1	99.2	99.4	99.6	†100.6	99.0	99.0	100.2	100.5	99.3	99.1	‡ 96.1	98.1	98.0	98.2	98.7
6	"	99.7	100.0	98.9	98.7	‡ 97.9	97.8	99.6	99.2	†100.1	99.1	99.8	99.4	99.2	98.7	†100.6	99.0	99.9	‡ 97.7	98.8	98.6	99.3	98.3
29	"	100.1	99.8	†100.2	99.2	98.4	‡ 97.6	99.4	98.8	99.6	99.3	†101.2	97.6	100.3	100.1	99.1	97.7	100.1	98.8	98.1	‡ 97.3	99.9	100.1
57	"	99.8	†100.7	100.3	99.4	‡ 96.6	99.1	99.3	99.8	100.2	100.2	100.4	98.9	99.1	100.0	†100.6	99.3	99.8	‡ 95.9	98.0	98.2	98.8	100.2
56	"	100.7	100.3	100.7	†101.5	100.4	‡ 99.8	100.1	100.0	100.2	100.1	100.0	99.7	†100.6	100.2	100.3	100.5	100.1	‡ 96.3	98.0	98.4	98.8	98.9
63	"	100.1	100.3	99.6	100.2	‡ 98.8	99.6	99.9	99.6	†100.6	99.3	99.7	100.0	100.2	100.0	†100.8	99.7	100.0	‡ 96.2	98.0	99.6	99.2	99.6
20	"	99.9	99.0	99.5	†100.2	98.7	‡ 97.9	99.0	99.3	98.5	99.2	‡ 98.4	99.1	100.3	99.7	100.6	†101.1	99.2	‡ 98.4	98.8	101.0	98.8	99.2
17	"	99.3	†100.4	99.9	†100.4	99.0	‡ 98.6	99.5	99.0	98.8	98.7	99.4	99.0	†100.3	99.7	100.0	100.2	99.9	100.0	99.6	100.2	‡ 97.7	99.1
16	"	100.0	100.0	†100.4	98.5	‡ 98.0	98.4	100.0	99.8	100.1	99.8	100.0	‡ 98.9	99.5	100.0	99.9	100.6	99.6	99.5	99.0	†100.8	99.9	99.4
2	"	99.2	‡ 98.7	99.8	† 99.9	99.0	99.1	99.8	99.6	99.2	99.0	98.5	‡ 97.7	99.4	97.9	99.2	99.0	99.0	99.2	99.6	†102.0	100.0	101.0
23	"	100.3	100.7	100.0	†102.6	‡ 98.8	100.0	100.4	102.0	100.9	99.0	‡100.2	100.5	100.8	101.5	102.2	†102.6	100.9	100.4	100.6	‡100.2	100.5	102.4
+22	"	‡ 95.6	98.6	99.3	†100.2	97.9	98.2	99.4	99.8	99.0	97.3	99.8	99.2	‡ 97.0	100.5	99.6	100.0	†101.3	99.4	99.5	100.3	99.6	99.1
69	"	100.7	†101.6	100.5	100.8	‡ 99.6	99.9	100.4	101.2	100.7	100.5	‡ 99.2	100.4	†101.5	101.3	100.6	100.1	100.8	100.2	100.0	100.2	100.8	99.6
67	"	100.6	†101.7	99.8	101.4	99.1	‡ 98.4	100.1	100.5	99.8	99.2	100.2	‡ 98.2	100.2	†101.8	101.5	100.4	100.9	99.2	100.7	100.2	100.4	100.0
59	"	102.3	†102.6	102.0	101.0	‡ 99.7	101.4	101.2	100.8	1[illegible]1.3	101.1	†101.9	100.8	101.7	101.6	101.0	101.6	100.4	‡ 99.2	100.7	100.5	100.5	99.9
77	"	101.5	101.4	100.8	†102.1	‡ 98.5	99.5	99.1	100.1	99.4	100.0	99.8	101.5	100.6	100.9	99.4	100.7	101.1	99.4	‡ 98.0	†101.7	100.4	100.7
82	"	100.8	†101.0	100.7	99.4	99.7	99.[illegible]	‡ 98.4	100.5	100.7	100.2	100.2	100.4	†101.4	101.0	101.0	100.7	100.6	‡ 99.1	99.5	100.7	100.2	99.2
78	"	100.8	100.3	101.0	100.4	‡ 99.3	101.1	100.2	†101.5	100.3	101.0	100.7	100.9	99.4	100.1	101.[illegible]	100.3	†101.5	‡ 97.2	99.2	100.0	99.1	99.[illegible]
74	"	99.6	94.5	100.2	100.0	‡ 98.8	†101.0	99.6	99.5	100.3	100.3	100.9	‡ 99.2	‡ 99.2	101.4	99.6	101.4	†101.5	99.9	100.3	100.6	100.4	100.6
79	"	100.3	100.2	99.7	†101.4	‡ 98.9	99.6	99.8	100.2	99.4	100.0	99.6	‡ 99.0	100.3	99.8	99.9	99.8	99.5	98.9	†100.5	100.4	100.2	99.9
80	"	100.8	‡ 99.6	100.2	†101.0	99.7	‡ 99.6	100.9	100.1	100.1	100.1	†100.7	99.6	100.4	99.8	100.2	100.0	100.2	‡ 98.0	98.1	99.0	100.2	99.6
76	"	100.8	100.1	100.3	100.5	‡ 99.1	99.8	99.8	100.2	100.9	†101.5	‡ 99.3	99.8	†100.2	100.0	100.1	100.1	‡ 99.3	†100.2	99.5	99.7	99.8	99.6
85	"	99.9	99.3	100.6	99.4	99.0	99.7	99.0	‡ 98.6	100.3	†101.0	‡ 99.1	100.7	100.2	102.2	100.7	†103.0	102.5	99.3	100.7	101.6	99.8	101.2
72	"	99.3	98.8	101.1	100.6	‡ 96.8	99.8	†101.5	97.2	100.2	100.5	99.8	100.0	99.6	99.2	100.0	†101.8	101.3	‡ 97.0	100.0	99.7	99.6	100.0
75	"	100.6	†101.4	100.9	100.1	‡ 97.1	97.8	99.2	99.6	100.1	100.4	100.1	100.4	99.1	†101.8	99.7	101.3	101.1	99.2	99.9	‡ 98.2	99.8	99.4

* Injection made at 7 p. m. March 31, 1898.

TABLE XVIII.

No. of animal.	Normal temperatures.									Normal temperatures.									
	March 28, 1898.									March 29, 1898.									
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
105	† 103.6	99.8	99.4	99.3	100.1	99.7	99.1	100.0	‡ 98.3	100.7	100.6	99.2	99.9	† 101.3	‡ 98.2	100.0	98.9	100.5	99.0
100	99.2	100.2	100.0	† 100.4	99.1	98.6	‡ 98.5	99.6	99.6	† 101.4	100.0	99.2	100.4	101.0	† 101.4	† 101.4	99.7	99.5	‡ 98.2
104	100.4	† 101.6	99.2	‡ 98.0	100.8	98.7	99.5	99.2	100.9	† 100.3	99.2	100.0	‡ 98.6	98.7	99.7	99.1	100.0	99.4	98.7
106	100.3	100.6	† 100.7	100.5	100.0	100.3	100.3	100.3	‡ 99.8	100.3	† 101.0	100.4	100.5	100.7	100.4	100.0	100.0	100.6	‡ 99.6
116	† 100.2	99.6	100.1	‡ 99.2	‡ 99.2	99.7	99.9	99.4	‡ 99.2	100.1	100.2	99.9	100.0	† 100.5	99.7	99.7	‡ 99.6	99.7	99.8
98	99.9	† 100.1	99.6	99.4	‡ 99.2	99.5	99.6	100.0	99.6	100.5	100.2	100.2	† 100.6	100.0	‡ 99.2	99.8	99.6	100.1	100.0
96	‡ 99.3	99.7	† 100.2	99.7	100.1	99.8	99.7	99.8	99.4	† 101.1	100.5	100.8	100.9	100.2	100.0	100.0	99.0	99.0	‡ 98.8
87	100.5	99.8	100.5	‡ 99.4	100.2	† 100.9	† 100.9	99.9	100.6	100.4	100.2	101.0	101.0	100.8	† 101.2	100.3	98.2	‡ 96.6	97.4
108	100.6	100.8	† 101.0	100.2	100.9	100.3	100.7	‡ 100.1	100.4	100.7	100.8	‡ 98.6	100.5	100.4	100.3	100.4	100.9	† 101.1	100.7
107	101.2	† 102.4	100.9	100.3	‡ 99.7	100.6	100.0	100.9	100.4	† 101.4	100.2	101.1	‡ 99.1	100.3	101.0	† 101.4	100.4	100.5	100.0
88	101.2	† 102.0	† 102.0	101.9	101.9	‡ 101.0	‡ 101.0	‡ 101.0	101.5	101.1	‡ 100.1	101.2	101.3	101.0	101.2	101.2	101.3	† 101.4	101.1
99	100.3	100.3	100.7	‡ 98.9	‡ 98.9	† 100.9	100.5	99.6	99.8	100.7	100.0	100.1	100.7	100.0	† 101.0	100.0	100.0	99.3	‡ 99.2
97	† 101.0	100.8	100.7	99.7	‡ 99.4	100.3	100.3	99.9	100.0	100.2	† 101.0	100.2	100.8	100.0	100.1	100.0	99.2	‡ 97.9	98.7
109	100.2	† 101.4	100.6	100.7	99.8	100.6	100.7	100.1	‡ 99.2	100.2	100.0	100.9	‡ 99.6	99.8	‡ 99.6	† 100.6	99.9	‡ 99.6	100.2
110	101.0	† 101.8	101.5	100.9	101.1	100.1	101.1	101.0	‡ 100.0	‡ 100.2	100.5	100.7	100.3	100.7	† 100.9	100.4	100.5	‡ 100.2	100.4
111	101.2	† 101.9	100.5	99.5	100.0	100.1	100.6	‡ 98.6	99.7	100.7	† 101.2	100.8	100.7	100.0	100.7	100.2	99.3	99.9	‡ 99.0
86	100.8	† 101.8	101.3	100.9	101.0	100.9	101.6	101.7	‡ 100.0	100.2	100.4	† 100.7	100.6	100.1	100.4	100.4	100.4	99.9	‡ 98.4
94	99.9	99.4	99.6	99.8	99.6	99.1	‡ 98.9	99.7	† 100.2	100.4	100.0	† 100.5	99.9	‡ 99.7	100.2	‡ 99.7	100.0	‡ 99.7	99.9
18	100.2	101.0	100.1	99.6	† 101.1	99.7	100.3	99.9	‡ 99.3	100.1	99.7	99.7	† 100.4	99.8	‡ 99.5	100.0	99.8	99.7	99.7
91	† 101.2	100.4	100.1	100.3	‡ 99.4	† 101.2	100.9	100.0	99.5	100.0	100.0	101.0	101.3	101.1	100.5	† 101.4	101.0	101.0	‡ 99.9
101	‡ 99.3	101.1	100.2	‡ 99.3	100.9	100.9	100.0	101.0	† 101.3	100.5	† 100.6	100.5	100.5	100.5	100.0	† 100.6	100.0	‡ 99.4	100.2
90	100.6	100.4	100.4	† 101.0	100.3	‡ 99.8	100.7	100.0	100.8	100.8	‡ 100.2	100.9	100.9	100.8	101.0	100.6	101.1	100.7	† 101.2
89	100.7	100.6	99.8	100.3	100.2	† 101.0	‡ 99.2	99.9	100.0	† 100.5	99.7	99.6	100.0	99.7	100.0	99.6	99.7	99.7	‡ 99.1
92	100.1	100.3	† 100.8	99.7	100.0	99.9	100.3	100.5	‡ 99.3	100.0	100.2	100.2	‡ 99.1	100.3	99.5	† 100.5	99.8	99.8	99.9
93	‡ 99.6	‡ 99.6	100.0	‡ 99.6	100.2	99.8	† 100.5	100.0	99.7	† 100.2	† 100.2	99.8	100.0	99.3	99.8	100.1	99.5	‡ 98.0	† 100.2
103	† 100.5	99.2	100.4	99.5	99.9	98.7	‡ 98.3	99.0	99.2	99.7	99.5	99.4	† 100.2	‡ 98.9	99.9	99.2	99.4	100.0	99.4
95	† 101.2	100.5	100.3	‡ 99.9	100.0	100.1	‡ 99.9	99.8	100.5	† 100.6	100.0	100.1	100.0	99.7	99.9	100.1	100.0	‡ 99.5	100.0
39	‡ 99.5	100.4	100.7	100.2	100.0	† 103.0	99.9	100.0	‡ 99.5	‡ 98.3	99.4	100.3	99.6	99.8	99.9	* 100.0	100.7	100.4	† 101.1

* Calf dropped during this interval.

TABLE XIX.

No. of animal.	Am't. injected.	Temperatures before injection.										Temperatures after injection.											
		March 31, 1898.										April 1, 1898.											
		7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	3 a. m.	4 a. m.	5 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.
*105	2 c. c.	100.1	98.9	†101.1	99.4	98.0	98.3	98.0	98.0	‡96.2	96.3	98.3	‡97.4	†97.7	98.0	98.6	98.4	100.1	98.8	98.6	97.9	98.3	99.0
100	"	99.3	100.1	†100.4	99.2	99.7	99.3	98.4	98.4	97.	‡96.8	‡96.0	97.2	98.2	98.9	100.0	98.8	98.4	100.0	98.0	98.7	97.2	†101.0
104	"	†101.2	99.4	100.6	98.9	100.0	98.9	98.7	98.4	‡98.8	97.7	97.3	99.6	98.3	98.2	99.0	‡97.0	99.0	†100.8	97.9	98.9	99.8	98.7
106	"	†101.2	100.4	101.0	101.0	100.6	100.0	99.6	98.3	‡97.8	98.8	100.3	99.5	99.8	99.3	100.7	99.8	100.7	†101.0	98.8	99.0	99.8	‡97.9
116	"	100.4	100.4	†100.5	100.1	100.4	99.6	99.4	99.6	‡97.0	97.6	98.5	99.2	98.9	99.5	99.6	†100.1	99.9	99.4	99.4	99.2	‡98.4	100.0
98	"	†101.0	100.0	100.4	100.4	100.4	100.7	99.7	100.2	‡96.9	97.4	99.2	99.5	99.1	100.4	†100.9	100.4	99.4	99.0	100.1	99.1	‡98.4	99.6
96	"	†100.6	100.4	†100.6	†100.6	100.0	100.4	99.9	100.2	‡98.3	98.4	99.2	‡98.7	100.0	99.9	†101.1	101.0	100.4	100.6	100.3	99.1	99.6	99.6
87	"	†101.6	100.2	101.0	100.7	100.6	101.0	100.5	99.5	96.7	‡96.4	99.7	99.7	99.4	100.0	100.4	100.2	†101.3	101.0	100.5	99.6	‡99.0	99.4
108	"	†101.3	101.0	100.6	100.7	101.0	100.1	100.3	100.1	‡99.3	99.6	‡99.2	99.5	99.9	100.4	100.9	†101.1	100.4	99.8	100.5	99.6	99.6	100.0
107	"	101.2	101.4	101.0	101.2	100.9	†101.5	101.1	101.4	‡98.0	99.3	99.5	99.4	‡99.1	101.3	101.5	†101.9	100.8	100.2	100.6	100.2	100.2	100.2
88	"	101.4	101.4	†101.6	101.3	†101.6	101.4	101.3	†101.6	‡100.2	100.8	100.8	101.3	101.5	100.9	101.2	101.6	†101.7	†101.7	101.3	‡100.0	‡100.0	100.8
93	"	100.2	†100.5	99.4	100	99.9	99.1	100.0	99.4	98.4	‡97.9	99.0	‡98.2	99.3	100.0	99.7	100.5	†101.0	1 0.6	100.8	99.4	99.3	100.0
97	"	100.8	†101.3	100.5	99.9	100.3	100.3	100.1	100.1	97.5	‡97.1	98.9	‡98.7	98.9	99.9	†100.4	100.1	100.2	100.2	100.1	99.9	99.6	99.4
109	"	100.6	†101.2	100.8	100.4	99.9	99.7	99.9	99.2	98.4	‡98.3	99.8	99.3	99.4	100.3	98.3	100.4	100.6	†100.9	99.6	100.0	‡98.8	99.0
110	"	101.4	†101.6	101.1	101.0	‡99.1	100.7	100.3	100.0	99.6	99.4	100.4	‡100.0	100.4	101.0	†101.6	100.9	00.9	‡100.0	100.9	100.3	100.4	100.7
+111	"	101.0	†101.2	101.1	100.7	100.0	99.9	100.0	100.0	98.1	‡97.4	100.8	‡99.7	100.5	102.1	102.8	104.4	†104.8	104.5	104.0	103.2	101.6	100.6
85	"	100.6	100.9	100.3	100.6	†101.1	100.3	100.0	100.2	‡98.4	99.6	‡99.5	99.6	‡99.5	100.7	101.4	101.4	101.3	101.5	†102.3	101.6	99.9	100.7
94	"	100.7	100.2	100.4	†101.9	100.8	100.4	100.2	99.8	‡99.6	99.8	99.4	99.8	99.2	100.1	99.9	100.9	100.8	99.4	†10 .0	100.9	98.1	‡97.7
18	"	‡99.1	†100.6	100.0	100.1	99.6	100.4	99.6	100.4	†100.6	100.3	99.1	99.2	98.5	100.1	99.8	†100.6	99.9	99.1	99.3	99.6	‡97.1	‡97.1
91	"	100.4	101.0	100.5	99.	100.8	00.0	100.4	99.8	†101.1	‡99.5	99.5	‡98.0	99.0	99.8	99.5	100.1	†100.6	100.3	99.8	100.0	98.7	99.7
101	"	†100.4	100.3	100.0	100.3	100.0	99.4	100.0	100.3	98.7	‡96.7	99.9	100.2	100.9	101.0	101.1	100.6	101.5	100.6	100.3	†101.6	‡98.4	99.0
90	"	101.1	101.2	101.0	‡99.5	100.4	100.9	†01.3	101.0	101.0	101.0	100.7	100.3	100.2	†101.4	100.4	100.6	100.0	100.8	100.6	101.2	‡98.2	99.0
89	"	99.2	100.0	†100.2	99.7	99.7	99.7	100.0	99.9	‡97.5	97.8	99.3	99.0	‡98.5	†100.4	99.2	99.7	100.0	99.0	99.5	99.7	99.8	100.1
92	"	†100.8	100.0	100.0	99.7	100.0	99.4	99.6	99.9	99.4	‡97.8	99.4	‡97.5	†100.3	100.2	99.4	99.9	†100.3	98.9	00.2	100.0	99.0	99.6
93	"	99.9	99.7	99.9	†100.0	99.4	99.7	‡99.0	99.8	99.4	99.4	99.1	99.2	99.0	100.0	99.9	100.0	†100.1	99.7	99.4	100.0	‡98.1	98.9
103	"	100.2	100.2	99.8	100.2	100.0	99.6	‡99.2	100.2	99.7	†100.7	98.5	99.2	97.2	99.8	†100.2	99.5	99.3	99.4	99.2	99.4	‡97.0	97.4
95	"	†101.3	99.7	100.9	100.2	100.6	‡99.4	99.7	99.8	100.1	99.6	98.7	98.9	98.9	99.8	†100.5	99.7	99.8	100.0	99.9	99.2	98.9	‡98.5
39	"	99.0	99.0	99.0	99.2	99.1	99.0	‡98.5	†99.9	99.3	99.4	98.9	‡98.2	99.0	99.0	99.7	99.3	†100.1	99.7	99.7	99.1	99.6	98.8

* Injection made at 7 p. m., March 31, 1898.

TABLE XX.

No. of animal.	Normal temperatures.									Normal temperatures.									
	March 28, 1898.									March 29, 1898.									
	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	7 a. m.	8 a. m	9 a m.	10 a. m.	11 a. m.	1 p m.	2 p m.	3 p. m.	4 p. m.	5 p m.
+ 10	98.2	98.2	98.2	98.8	98.6	‡ 97.7	98.8	† 99.4	98.0	98.3	98.0	98.1	97.7	‡ 97.0	98.9	99.2	98.6	† 99.9	99.1
+ 7	99.2	97.8	99.4	99.4	98.8	98.3	98.3	† 99.7	‡ 97.3	100.1	98.6	† 100.6	99.2	‡ 97.7	98.9	99.6	98.7	98.9	99.3
+ 21	99.1	99.9	‡ 98.4	† 100.0	98.8	98.8	98.6	99.4	† 100.0	99.3	98.8	† 99.4	99.2	99.2	98.5	‡ 97.9	99.2	100.0	99.3
+ 24	99.7	99.8	† 99.9	99.2	99.5	† 99.5	‡ 98.2	98.3	99.6	† 100.4	98.6	99.5	99.3	98.8	99.1	98.9	98.1	‡ 97.4	98.9
+ 4	‡ 97.7	98.2	99.8	99.9	99.8	99.2	† 100.3	99.7	99.1	† 101.3	99.2	100.5	99.9	98.9	‡ 98.6	100.6	99.7	100.9	100.9
+ 49	99.1	99.1	‡ 97.2	100.0	98.1	98.5	† 100.8	99.6	98.1	† 100.4	99.4	98.1	99.8	99.7	99.3	99.7	‡ 97.8	100.2	100.3
+ 30	98.5	98.8	98.6	‡ 96.7	97.8	99.4	98.3	† 99.8	98.8	100.5	† 100.6	98.1	98.1	‡ 96.8	99.0	98.2	98.5	99.2	98.8
+ 32	† 99.7	97.8	98.3	98.2	97.8	‡ 96.7	96.9	98.6	† 99.7	‡ 96.8	100.2	97.2	‡ 96.8	96.9	99.2	97.5	96.9	99.6	† 100.7
5	‡ 96.8	‡ 96.8	‡ 96.8	99.7	97.5	97.9	† 99.8	98.0	97.4	99.4	98.8	98.0	† 100.6	98.3	‡ 97.4	99.4	98.3	98.7	99.0
+ 26	98.9	‡ 97.8	98.6	99.0	98.8	99.8	99.1	† 100.1	99.5	98.1	98.7	97.7	98.4	‡ 97.6	† 98.8	98.3	98.3	98.6	98.1
134	99.6	98.9	‡ 98.2	100.1	100.3	98.5	101.6	98.5	† 100.7	98.8	99.0	† 100.4	98.0	98.5	‡ 96.9	‡ 96.9	97.8	98.3	99.2
135	101.7	100.2	‡ 97.4	101.5	101.4	101.7	101.6	101.7	† 102.2	100.2	100.6	† 101.4	100.4	99.6	‡ 98.9	100.7	100.7	100.5	101.2
+ 37	99.7	† 99.8	‡ 97.5	99.4	98.7	98.8	99.4	98.5	99.1	98.1	‡ 97.5	98.5	98.7	98.8	98.8	98.3	99.1	99.5	† 99.6

TABLE XXI.

No. of animal.	Am't injected.	Temperatures before injection.										Temperatures after injection.											
		March 31, 1898.										April 1, 1898.											
		7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	4 a. m.	5 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.
*+10	2 c. c.	†99.7	99.3	97.7	‡97.1	97.2	98.4	97.9	99.0	98.6	98.4	97.7	99.3	†99.8	98.8	99.2	96.9	98.3	‡96.7	98.4	97.8	98.3	98.0
+ 7	"	99.7	98.9	97.5	‡96.7	97.3	98.5	99.7	100.4	100.0	†100.6	98.6	98.1	98.0	†100.1	98.3	‡96.7	97.5	97.3	98.7	99.2	99.3	98.5
+21	"	99.8	99.9	99.2	99.4	‡98.6	†100.2	99.1	98.8	99.4	99.6	‡97.4	99.4	100.0	99.2	98.8	99.6	98.7	100.0	98.2	98.3	†100.3	99.8
+24	"	99.7	†100.6	98.5	‡98.3	98.8	99.4	98.7	99.6	99.4	99.4	99.1	99.1	‡98.6	99.8	100.2	99.1	99.4	†100.3	99.0	99.9	100.0	100.1
+ 4	"	99.9	100.3	99.5	‡97.3	98.2	101.9	102.4	100.6	101.3	†103.9	101.9	99.9	100.4	98.6	98.7	99.6	‡98.2	99.4	98.4	99.3	98.9	†101.5
+49	"	99.9	100.3	‡97.8	99.2	98.6	100.4	99.6	†101.3	99.7	99.7	99.7	‡98.8	99.3	100.3	99.5	99.3	99.8	†103.3	102.8	102.7	102.8	101.6
+30	"	98.7	99.7	98.7	†99.9	†98.5	99.5	99.1	†99.9	99.1	99.3	100.1	99.3	98.8	‡98.7	98.9	98.9	100.2	101.2	101.6	100.8	101.2	†102.6
+32	"	100.0	98.6	98.1	97.0	98.6	‡96.9	98.6	‡96.9	‡96.9	†100.6	100.6	100.9	102.3	101.4	101.4	101.6	†103.5	101.9	101.4	99.1	‡99.0	‡99.0
+ 5	"	98.6	99.2	99.4	97.8	97.6	‡97.2	†100.8	99.3	97.9	97.9	100.4	97.7	98.9	99.6	‡97.3	98.5	97.7	101.2	99.6	†101.9	101.7	101.3
+26	"	98.6	99.1	98.8	97.8	98.5	†99.8	98.6	‡97.4	98.4	98.9	‡97.6	98.6	99.2	99.5	99.5	98.8	99.7	101.8	102.1	†103.0	101.0	102.1
134	1 c. c.	100.1	100.1	98.1	101.0	98.6	‡97.9	98.0	100.7	†101.6	99.9	98.9	98.5	98.2	100.4	98.6	†101.3	99.8	‡98.0	98.1	99.5	98.2	100.2
135	"	‡99.8	100.9	99.9	100.8	100.9	101.4	101.8	†102.4	102.0	102.1	‡99.1	101.2	100.9	100.8	100.1	99.7	100.8	100.7	†101.4	100.5	100.2	100.9
+37	2 c. c.	98.2	98.8	98.8	99.5	98.0	100.0	98.8	†97.8	†100.5	99.2	98.9	‡98.4	98.6	98.7	100.9	100.6	101.6	†102.4	102.1	101.8	101.2	101.8

* Injection made at 8 p. m. March 31, 1898.

STUDY OF NORMAL MAXIMAL TEMPERATURES.

The term normal in this connection refers to those temperatures taken previous to the injection of tuberculin and those which are so designated in the tables. Every condition was observed to maintain the usual environments and circumstances to which the cattle were accustomed every day prior to the taking of temperatures. So far as it was possible every feature was removed which would preclude errors in the obtaining of normal records upon which we could base our reasons for condemnation.

In a study of the normal maximal temperature, which is so frequently the guide in the condemnation of animals, it is our purpose to show primarily the extent of variation which may take place even when the highest limit of temperature is taken only. The table that follows will fairly illustrate this point because it is a simple record of the normal maximal temperatures and the time when they occurred.

Study of Normal Maximal Temperatures.

No. of animal.	March 31, 1896.	May 11, 1896.	August 20, 1896.	August 26, 1896	April 20, 1897.	April 22, 1897.	October 12, 1897.	October 13, 1897.	March 28, 1898.	March 29, 1898.	March 31, 1898.	Lowest maximal temperature.	Highest maximal temperature.	Degrees of variation.
1	101.0													
2	100.8	101.7			101.2		102.4	102.2	100.8	100.7	99.9	99.9	102.4	2.5
3	102.3													
4	101.8				101.5			101.9	100.3	101.3	103.9	100.3	103.9	3.6
5	102.3				102.0		101.8	101.3	99.8	100.6	100.8	99.8	103.3	2.5
6	102.2				101.4				106.4	100.7	100.1	100.1	106.4	5.3
7	101.7				101.1		101.3	101.6	99.7	100.6	100.6	99.7	101.7	2.0
8	101.6													
9	101.2				101.2		101.4	101.4	100.7	100.2	99.9	99.9	101.4	1.5
10	101.2			102.1		101.5		102.2	99.4	99.9	99.7	99.4	102.2	2.8
11	102.8				101.6				100.9	101.3	100.5	100.5	102.8	2.3
12	102.3				102.0							102.0	102.3	.3
13	102.2				101.5		101.2	101.1	100.7	102.0	102.0	100.7	102.2	1.5
14	102.5				101.4		102.2	101.7	100.2	100.0	100.4	100.0	102.5	2.5
15	102.1	101.8	101.5		102.4				101.2	102.0	101.5	101.2	102.4	1.2
16	102.6	103.2			101.2		101.6	101.5	101.3	99.6	100.4	99.6	103.2	3.6
17	101.4	101.4			101.4		100.8	100.8	100.6	104.2	100.4	100.4	104.2	3.8
18	101.8				101.5							101.5	101.8	.3
19	101.6	102.1										101.6	102.1	.5
20	102.6				101.8				102.3	100.5	100.2	100.2	102.6	2.4
21	101.3	102.0			101.5			103.3	100.0	99.4	100.2	99.4	103.3	3.9
22	101.2			102.1		101.8		101.6	100.9	100.2	100.2	100.2	102.1	1.9
23	103.6				101.0		101.1	101.3	102.0	101.9	102.6	101.0	103.6	2.6
24	101.2			103.0		101.7		102.8	99.9	100.4	100.6	99.9	103.0	3.1
25	103.0	102.8										102.8	103.0	.2
26	102.0				101.6			100.7	100.1	98.8	99.8	98.8	102.0	3.2
27	102.9				101.4							101.4	102.9	1.5
28	101.7		104.0		101.3							101.3	104.0	2.7
29	101.8				101.2				100.7	100.6	100.2	100.2	101.8	1.6
30	102.0	101.8	101.6			101.2		102.2	99.8	100.6	99.9	99.8	102.2	2.4
31	102.0			102.1		101.4						101.4	102.1	.7
32	102.0				102.2			102.5	99.7	100.7	100.6	99.7	102.5	2.8
33	102.0			102.4		101.6		102.2				101.6	102.4	.8
34	102.0	102.4	101.6		102.0							101.6	102.4	.8
35	101.8													
36	102.3													
37	101.4	102.2	101.9		101.5			102.0	99.8	99.6	100.5	99.6	102.2	2.6
38	102.0	101.8	101.6			101.2						101.2	102.0	.8
39	102.2	101.2			101.6				103.0	101.1	99.9	99.9	103.0	3.1
40	102.4													
41	100.8			101.6		101.4						100.8	101.6	.8
42	101.9			102.2		102.6		101.9				101.9	102.6	.7
43	102.0				101.4				99.8	99.9	101.5	99.8	102.0	2.2
44	101.4				100.8		101.3	100.3	99.5	99.7	100.0	99.5	101.4	1.9
45	101.6	102.0	100.4		102.2				98.8	99.2	101.3	98.8	102.2	3.4
46	102.4				101.3							101.3	102.4	1.1
47	102.0	103.4										102.0	103.4	1.4
48	102.1													
49	102.6			102.2	102.4			102.6	100.8	100.4	101.3	100.4	102.6	2.2
50	101.3	102.9	101.2									101.2	102.9	1.7
51	101.8	103.9	101.7									101.7	103.9	2.2
52	101.5				101.6		102.3	101.6	98.9	101.0	99.9	98.9	102.3	3.4
53	102.9				101.9		101.5	101.7	102.0	103.6	100.6	100.6	103.6	3.0
54	103.5	102.7		102.7								102.7	103.5	.8
55	102.3													
56	101.3	102.1	102.4		102.3				101.5	100.5	101.5	100.5	102.4	1.9
57	101.9				102.0				102.3	101.7	100.7	100.7	102.3	1.6
58			102.8											

Study of Normal Maximal Temperatures.—Continued.

No of animal.	March 31, 1896.	May 11, 1896.	August 20, 1896.	August 26, 1896.	April 20, 1897.	April 22, 1897.	October 12, 1897.	October 13, 1897.	March 28, 1898.	March 29, 1893.	March 31, 1898.	Lowest maximal temperature.	Highest maximal temperature.	Degrees of variation.
59	------	----	103.0	------	101.6	------	101.7	101.5	102.5	102.8	102.6	101.5	103.0	1.5
60	------	104.9	------	------	------	------	------	------	------	------	------	------	------	----
61	------	------	105.0	------	------	------	------	------	------	------	------	------	------	----
62	------	------	103.1	------	------	------	------	------	------	------	------	------	------	----
63	------	102.0	102.5	------	102.3	------	------	------	100.7	101.0	100.6	100.6	102.5	1.9
64	------	102.5	102.3	103.2	102.2	------	------	------	------	------	------	102.2	103.2	1.0
65	------	102.5	101.9	101.8	102.5	------	------	------	------	------	------	101.8	102.5	.7
66	------	102.9	103.1	103.4	------	------	------	------	------	------	------	102.9	103.4	.5
67	------	------	------	103.0	103.6	------	------	------	102.0	102.8	101.7	101.7	103.6	1.9
68	------	------	------	102.6	101.4	------	------	------	100.2	98.7	100.2	98.7	102.6	3.9
69	------	------	------	103.0	103.1	------	------	------	102.0	103.9	101.6	101.6	103.9	2.3

No. of animal.	April 20, 1897.	April 22, 1897.	October 12, 1897.	October 13, 1897.	March 28, 1898.	March 29, 1898.	March 31, 1898.	Lowest maximal temperature.	Highest maximal temperature.	Degrees of variation.
70	102.3	--------	--------	--------	100.2	99.6	101.6	99.6	102.3	2.7
71	101.4	--------	--------	--------	--------	--------	--------	--------	--------	-----
72	102.7	--------	--------	--------	--------	--------	--------	--------	--------	-----
73	101.9	--------	--------	--------	102.0	101.0	101.3	101.0	102.0	1.0
74	102.0	--------	--------	--------	101.2	102.1	101.0	101.0	102.1	1.1
75	101.4	--------	101.3	100.7	101.9	100.9	101.4	100.7	101.9	1.2
76	102.1	--------	--------	--------	102.1	102.2	101.5	101.5	102.2	.7
77	103.2	--------	--------	--------	101.7	101.8	102.1	101.7	103.2	1.5
78	102.4	--------	--------	--------	101.4	101.4	101.5	101.4	102.4	1.0
79	103.1	--------	--------	--------	101.5	100.3	101.4	100.3	103.1	2.8
80	102.8	--------	--------	--------	101.5	101.7	101.0	101.0	102.8	1.8
81	102.0	--------	--------	--------	--------	--------	--------	--------	--------	-----
82	103.1	--------	--------	--------	100.6	100.9	101.0	100.6	103.1	2.5
83	--------	102.4	--------	102.2	--------	--------	--------	102.2	102.4	.2
84	102.2	--------	--------	--------	--------	--------	--------	--------	--------	-----
85	101.9	--------	--------	--------	101.6	97.3	101.0	97.3	101.9	4.6

No. of animal.	September 3, 1897.	September 4, 1897.	September 6, 1897.	October 13, 1897.	March 28, 1898.	March 29, 1898.	March 31, 1898.	Lowest maximal temperature.	Highest maximal temperature.	Degrees of variation.
86	103.0	102.6	102.0	--------	101.8	100.7	101.1	100.7	103.0	2.3
87	102.6	101.8	102.5	--------	100.9	101.2	101.6	100.9	102.6	1.7
88	101.9	101.7	102.3	--------	102.0	101.4	101.6	101.4	102.3	.9
89	102.3	101.8	102.4	--------	101.0	100.5	100.2	100.2	102.4	2.2
90	101.1	100.9	102.2	--------	101.0	101.2	101.3	100.9	102.2	1.3
91	102.6	102.2	102.4	--------	101.2	101.4	101.1	101.1	102.6	1.5
92	101.9	101.8	102.1	--------	100.8	100.5	100.8	100.5	102.1	1.6

Study of Normal Maximal Temperatures.—Concluded.

No. of animal.	September 3, 1897.	September 4, 1897.	September 6, 1897.	October 12, 1897.	October 13, 1897.	March 28, 1898.	March 29, 1898.	March 31, 1898.	Lowest maximal temperature.	Highest maximal temperature.	Degrees of variation.
93	102.3	101.5	102.1			100.5	100.2	100.0	100.0	102.3	2.3
94	102.5	103.3	102.6			100.2	100.5	101.9	100.2	103.3	3.1
95	102.0	101.9	102.4			101.2	100.6	101.3	100.6	102.4	1.8
96	102.2	102.9	102.2			100.2	101.1	100.6	100.2	102.9	2.7
97	103.8	103.6	103.4			101.0	101.0	101.3	101.0	103.8	2.8
98	102.1	102.1	102.4			100.1	100.6	101.0	100.1	102.4	2.3
99	102.8	102.0	102.7			100.9	101.0	100.5	100.5	102.8	2.3
100	102.4	102.3	102.4			100.4	101.4	100.4	100.4	102.4	2.0
101				101.1	100.9	101.3	100.6	100.4	100.4	101.3	.9
102											
103				101.7	101.4	100.5	100.2	100.7	100.2	101.7	1.5
104				101.4	101.3	101.6	100.3	101.2	100.3	101.6	1.3
105				101.3	101.2	103.6	101.3	101.1	101.1	103.6	2.5
106				101.8	102.4	100.7	101.0	101.2	100.7	102.4	1.7
107				101.4	101.0	102.4	101.4	101.5	101.0	102.4	1.4
108				101.1	101.4	101.0	101.1	101.3	101.0	101.4	.4
109				101.0	101.3	101.4	100.6	101.2	100.6	101.4	.8
110				102.4	101.7	101.8	100.9	101.6	100.9	102.4	1.5
111				101.5	102.3	101.9	101.2	101.2	101.2	102.3	1.1
112				102.3	101.8	99.9	101.0	101.8	99.9	102.3	2.4
113				102.8	102.9	101.8	101.6	101.7	101.6	102.9	1.3
114				103.0	101.9	102.2	100.5	100.6	100.5	103.0	2.5
115				103.3	102.6	101.8	100.7	100.4	100.4	103.3	2.9
116						100.2	100.5	100.5	100.2	100.5	.3
117						100.6	103.1	101.8	100.6	103.1	2.5
118						102.2	100.8	101.5	100.8	102.2	1.4
119						100.1	100.7	101.6	100.1	101.6	1.5
120						101.5	101.8	100.9	100.9	101.8	.9
121						101.2	101.4	101.7	101.2	101.7	.5
122						102.2	101.1	101.2	101.1	102.2	1.1
123						101.8	101.4	101.7	101.4	101.8	.4
124						103.8	101.7	100.7	100.7	103.8	3.1
125						101.1	103.1	101.2	101.1	103.1	2.0
126						100.3	101.1	101.3	100.3	101.3	1.0
127						102.3	99.9	101.9	99.9	102.3	2.4
128						102.0	101.0	102.3	101.0	102.3	1.3
129						101.6	101.8	102.1	101.6	102.1	.5
130						101.5	102.5	102.6	101.5	102.6	1.1
131						102.3	102.6	102.2	102.2	102.6	.4
132						103.1	103.1	102.2	102.2	103.1	.9
133						101.6	101.6	102.3	101.6	102.3	.7
134						100.7	100.4	101.6	100.4	101.6	1.2
135						102.2	101.4	102.4	101.4	102.4	1.0
136								100.0			

From the above table, the normal maximal temperatures, it will be noted, range in variation from a fraction of a degree to over five degrees. These temperatures, it is true, cover a period of two years; yet some of the greatest variations are found occurring during two successive days. This may be noted in the cases of Nos. 5 and 17 and in a less marked degree in Nos. 20, 39, 53, 69, 105, 114 and others. Owing to this great variation in normal maximal temperatures we feel justified in bidding caution to all operators in the tuberculin test. The too prevalent method of finding the maximal temperatures of the day of and the day after injection and condemning animals in accordance with this standard without any further investigation may be the means of unnecessary destruction of property. There are cases where this would be legitimately allowable as we shall see later in a survey of reactions, but when it is applied irrespective of other features it cannot be justified. Where there is a possibility of five degrees of variation in normal maximal temperatures, two degrees cannot be taken as the sole criterion for placing the stamp of "tuberculous" upon an animal.

It does seem incredible to learn from various sources that skilled men have tested thousands of cattle with only two or three errors per thousand and those errors on the side of obtaining no reaction in tuberculous cattle, when normal temperatures of ninety-eight cattle belonging to the M. A. C. herd. this spring, would have practically condemned four. If the variation is taken as two degrees irrespective of days, nine would have been condemned. (See above tables for March 28 and 29, 1898). These temperatures were taken in exactly the same way as we would take them in a regular test, omitting two or three hours in the early morning. None of these variations occurred in the eleven cattle which had already been condemned at a previous test. This certainly indicates that we must proceed with much circumspection, otherwise, tuberculin will be thrown into disrepute, notwithstanding the hyper-enthusiastic spirit which is exercised in its behalf. Let us hold to its real value.

SUDDEN CHANGES IN TEMPERATURE.

We frequently find the maximal and minimal temperatures for the day occurring within one hour of each other. This is of interest not only from the suddenness of the change, but its bearing upon the interpretations made. It is maintained by some operators that this suddenness of change is due to the thermometer. Perhaps in some cases this is true, for where a thermometer is encased, the case may become cold, so that, upon insertion, the temperature would not be recorded accurately in three minutes time. I have met with this very trouble in the course of my work; but when the taking of the temperature is repeated with the greatest care and the temperature shows a sudden change, some other agency must be at work.

We wish to give some of these sudden changes as we find them scattered through the tables.

Table.	No. of animal.	Time.	Temperature.	Time.	Temperature.	Date.
*I	11	2 p. m.	102.8	6 p. m.	101.9	March 31, 1898.
	12	8 a. m.	100.6	10 a. m.	102.3	" 31, 1898.
	16	2 p. m.	102.6	6 p. m.	101.8	" 31, 1898.
	17	2 p. m.	101.4	6 p. m.	100.4	" 31, 1898.
	18	12 m.	101.8	2 p. m.	98.8	" 31, 1898.
	19	12 m.	100.4	2 p. m.	101.6	" 31, 1898.
	20	2 p. m.	102.6	6 p. m.	101.0	" 31, 1898.
	28	8 a. m.	101.7	10 a. m.	101.0	" 31, 1898.
IX	86	8 a. m.	101.6	9 a. m.	103.0	September 3, 1897.
	88	7 a. m.	101.7	8 a. m.	101.0	" 4, 1897.
	92	3 p. m.	100.4	4 p. m.	101.8	" 4, 1897.
	93	10 a. m.	102.3	11 a. m.	100.7	" 3, 1897.
	95	11 a. m.	101.9	1 p. m.	100.8	" 4, 1897.
	96	9 a. m.	102.2	10 a. m.	100.8	" 3, 1897.
	98	11 a. m.	102.1	1 p. m.	100.8	" 3, 1897.
	99	10 a. m.	100.6	11 a. m.	102.8	" 3, 1897.
	99	11 a. m.	102.0	1 p. m.	101.2	" 4, 1897.
	100	8 a. m.	102.4	9 a. m.	101.3	" 3, 1897.
XI	14	8 a. m.	102.2	9 a. m.	101.2	October 12, 1897.
	109	2 p. m.	100.0	3 p. m.	101.3	" 13, 1897.
	111	11 a. m.	100.4	1 p. m.	101.5	" 12, 1897.
	110	3 p. m.	100.9	4 p. m.	102.4	" 12, 1897.
	110	11 a. m.	100.6	1 p. m.	101.7	" 13, 1897.
	107	4 p. m.	100.3	5 p. m.	101.4	" 12, 1897.
	101	8 a. m.	101.1	9 a. m.	99.5	" 12, 1897.
	106	11 a. m.	100.7	1 p. m.	101.8	" 12, 1897.
	105	8 a. m.	101.2	9 a. m.	100.1	" 13, 1897.
XIV	130	9 a. m.	102.5	10 a. m.	99.2	March 29, 1898.
	132	1 p. m.	99.8	2 p. m.	103.1	" 28, 1898.
	44	8 a. m.	97.3	9 a. m.	99.7	" 28, 1898.
	43	10 a. m.	96.4	11 a. m.	99.8	" 28, 1898.
	126	9 a. m.	100.3	10 a. m.	98.1	" 28, 1898.
	126	4 p. m.	97.9	5 p. m.	101.1	" 29, 1898.
	122	7 a. m.	96.4	8 a. m.	101.1	" 29, 1898.
	52	9 a. m.	97.3	10 a. m.	101.0	" 29, 1898.
	121	11 a. m.	101.4	1 p. m.	99.0	" 29, 1898.
	53	4 p. m.	102.0	5 p. m.	99.3	" 28, 1898.
	53	7 a. m.	99.8	8 a. m.	103.6	" 29, 1898.
	112	9 a. m.	99.9	10 a. m.	97.2	" 28, 1898.
	113	11 a. m.	98.4	1 p. m.	101.8	" 28, 1898.
	120	4 p. m.	101.5	5 p. m.	99.4	" 28, 1898.
	117	11 a. m.	100.6	1 p. m.	98.8	" 28, 1898.
	117	7 a. m.	99.1	8 a. m.	103.1	" 29, 1898.
XV	13	9 a. m.	100.7	10 a. m.	99.0	" 28, 1898.
	15	10 a. m.	99.2	11 a. m.	101.2	" 28, 1898.
	20	1 p. m.	98.7	2 p. m.	100.5	" 29, 1898.
	16	7 a. m.	99.6	8 a. m.	98.3	" 29, 1898.
	23	9 a. m.	101.9	10 a. m.	99.2	" 29, 1898.
	22	3 p. m.	98.6	4 p. m.	100.9	" 28, 1898.
	22	9 a. m.	98.6	10 a. m.	100.2	" 29, 1898.
	59	10 a. m.	102.8	11 a. m.	100.5	" 29, 1898.
	82	10 a. m.	100.9	11 a. m.	99.3	" 29, 1898.
	85	8 a. m.	101.6	9 a. m.	99.2	" 28, 1898.
	72	7 a. m.	96.9	8 a. m.	101.0	" 29, 1898.
	75	10 a. m.	100.9	11 a. m.	99.0	" 29, 1898.
XVIII	105	11 a. m.	101.3	1 p. m.	98.2	" 29, 1898.
	99	1 p. m.	98.9	2 p. m.	100.9	" 28, 1898.
	91	1 p. m.	99.4	2 p. m.	101.2	" 28, 1898.
	89	2 p. m.	101.0	3 p. m.	99.2	" 28, 1898.
	93	4 p. m.	98.0	5 p. m.	100.2	" 29, 1898.
	103	10 a. m.	100.2	11 a. m.	98.9	" 29, 1898.
XX	7	4 p. m.	99.7	5 p. m.	97.3	" 28, 1898.
	21	10 a. m.	98.4	11 a. m.	100.0	" 28, 1898.
	24	2 p. m.	99.9	3 p. m.	98.2	" 28, 1898.
	26	11 a. m.	97.6	1 p. m.	98.8	" 29, 1898.
	37	9 a. m.	99.8	10 a. m.	97.5	" 29, 1898.

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* Table I is the result of test applied by Prof. E. A. A. Grange.

The above table adds materially to the evidence of great variation and also demonstrates that this variation may be very sudden. Here we are inclined to criticise operators who have made a practice of taking only one or two temperatures. These sudden and decided changes cannot be taken into account when only a single temperature is considered, and it is difficult to understand how a good judgment may be formed from so limited data. The greater the number of normal temperatures we have of an animal the better may we be able to discover any influence of tuberculin. Of course, there is a limit to practicability. The expense of a test must be taken into account, accordingly the number of normal temperatures must be confined to a definite period. The rule should be made, take as many normal temperatures as it is feasible to take. Keep all the records and compare them each time. It may be that the different seasons of the year exert an influence or that a cold day or warm day has its power in producing a change. For these reasons we shall make a comparative study of seasons as to their effect in modifying temperature in animals.

INFLUENCE OF SEASONS OR ATMOSPHERIC TEMPERATURE UPON TEMPERATURE OF ANIMALS.

All the material in the tables will not be used to demonstrate this point, but will confine my attention to Table IX of normal temperatures taken September 3d and 4th, 1897, during very warm weather, and the normal temperatures of the same animals taken March 28th and 29th, 1898, when the air was quite cool but not cold. While the following table does not comprise all the data, it will give sufficient to establish this point, whether atmospheric temperature has any influence or not upon animal heat. A further study of other tables conveys the same testimony, but too much space would be required to bring all the facts together at this place. We shall, therefore, content ourselves with a single table.

No. of animal.	Date.	8 a. m.	9 a. m	10 a. m	11 a. m.	1 p. m.	2 p m.	3 p. m.	4 p. m.	5 p. m.
86	Sept. 3, 1897	101.6	103.0	102.3	102.5	102.6	101.7	101.7	102.1	102.8
86	Mar. 28, 1898	100.8	101.8	101.3	100.9	101.0	100.9	100.9	101.7	100.0
86	Sept. 4, 1897	101.6	101.8	101.6	101.6	101.0	101.5	100.4	102.1	102.6
86	Mar. 29, 1898	100.4	100.7	100.6	100.1	100.4	100.4	100.4	99.9	98.4
87	Sept. 3, 1897	101.6	101.6	101.0	101.5	101.7	102.2	102.1	102.6	102.6
87	Mar. 28, 1898	100.5	99.8	100.5	99.4	100.2	100.9	100.9	99.9	100.6
87	Sept. 4, 1897	101.5	101.6	101.5	101.7	101.0	101.6	101.6	101.6	101.8
87	Mar. 29, 1898	100.2	101.0	101.0	100.8	101.2	100.3	98.2	96.6	97.4
88	Sept. 3, 1897	101.2	101.4	101.0	101.4	101.4	101.7	101.5	101.9	101.6
88	Mar. 28, 1898	101.2	102.0	102.0	101.9	101.9	101.0	101.0	101.0	101.5
88	Sept. 4, 1897	101.0	101.4	101.1	101.6	101.2	101.1	101.4	101.1	101.5
88	Mar. 29, 1898	100.1	101.2	101.3	101.0	101.2	101.2	101.3	101.4	101.1
89	Sept. 3, 1897	101.1	101.0	100.2	101.1	101.3	102.3	102.0	101.6	101.9
89	Mar. 28, 1898	100.7	100.6	99.8	100.3	100.2	101.0	99.2	99.9	100.0
89	Sept. 4, 1897	100.9	100.5	100.9	101.3	101.0	100.9	101.3	101.4	101.8
89	Mar. 29, 1898	99.7	99.6	100.0	99.7	100.0	99.6	99.7	99.7	99.1
90	Sept. 3, 1897	100.8	100.7	100.6	100.3	100.2	100.4	100.4	100.7	101.1
90	Mar. 28, 1898	100.6	100.4	100.4	101.0	100.3	99.8	100.7	100.0	100.8
90	Sept 4, 1897	100.6	100.5	99.9	100.7	100.5	100.2	100.3	100.3	100.9
90	Mar. 29, 1898	100.2	100.9	100.9	100.8	101.0	100.6	101.1	100.7	101.2
91	Sept. 3, 1897	101.3	101.2	101.1	101.3	101.5	101.6	101.7	102.1	102.6
91	Mar. 28, 1898	101.2	100.4	100.1	100.3	99.4	101.2	100.9	100.0	99.5
91	Sept 4, 1897	101.1	101.5	101.0	101.8	101.0	101.2	101.5	102.2	102.2
91	Mar. 29, 1898	100.0	101.0	101.3	101.1	100.5	101.4	101.0	101.0	99.9
92	Sept. 3, 1897	101.5	101.3	101.4	101.5	101.6	101.4	101.7	101.9	101.9
92	Mar. 28, 1898	100.1	100.3	100.8	99.7	100.0	99.9	100.3	100.5	99.3
92	Sept. 4, 1897	101.6	101.6	101.1	101.2	100.4	100.9	100.4	101.8	101.8
92	Mar. 29, 1898	100.2	100.2	99.1	100.3	99.5	100.5	99.8	99.8	99.9
93	Sept. 3, 1897	101.1	100.9	102.3	100.7	100.8	101.2	101.2	101.4	101.6
93	Mar. 28, 1898	99.6	99.6	100.0	99.6	100.2	99.8	100.5	100.0	99.7
93	Sept. 4, 1897	101.1	101.4	101.4	101.4	100.7	101.1	101.0	101.0	101.4
93	Mar. 29, 1898	100.2	99.8	100.0	99.3	99.8	100.1	99.5	98.0	100.2
94	Sept. 3, 1897	101.6	101.4	101.3	101.5	101.8	102.2	102.5	101.6	101.7
94	Mar. 28, 1898	99.9	99.4	99.6	99.8	99.6	99.1	98.9	99.7	100.2
94	Sept. 4, 1897	101.7	101.6	101.9	102.1	102.0	102.5	102.6	102.4	103.3
94	Mar. 29, 1898	100.0	100.5	99.9	99.7	100.2	99.7	100.0	99.7	99.9
95	Sept. 3, 1897	102.0	101.7	101.5	101.5	101.2	101.6	101.3	101.6	102.0
95	Mar. 28, 1898	101.2	100.5	100.3	99.9	100.0	100.1	99.9	99.8	100.5
95	Sept. 4, 1897	101.7	101.6	101.7	101.9	100.8	101.4	100.9	101.0	101.2
95	Mar. 29, 1898	100.0	100.1	100.0	99.7	99.9	100.1	100.0	99.5	100.0
96	Sept. 3, 1897	101.3	102.2	100.8	100.9	101.0	101.5	101.3	101.8	102.0
96	Mar. 28, 1898	99.3	99.7	100.2	99.7	100.1	99.8	99.7	99.8	99.4
96	Sept. 4, 1897	101.3	101.2	101.4	102.9	101.4	101.0	100.9	101.4	101.7
96	Mar. 29, 1898	100.5	100.8	100.9	100.2	100.0	100.0	99.0	99.0	98.8
97	Sept. 3, 1897	102.4	103.4	102.0	102.1	102.4	103.6	102.9	103.8	103.0
97	Mar. 28, 1898	101.0	100.8	100.7	99,7	99.4	100.3	100.3	99.9	100.0
97	Sept. 4, 1897	102.1	102.6	102.4	103.2	102.7	103.0	103.6	102.4	102.6
97	Mar. 29, 1898	101.0	100.2	100.8	100.0	100.1	100.0	99.2	97.9	98.7
98	Sept. 3, 1897	101.0	101.3	101.2	102.1	100.8	101.7	101.5	101.3	101.2
98	Mar. 28, 1898	99.9	100.1	99.6	99.4	99.2	99.5	99.6	100.0	99.6
98	Sept. 4, 1897	101.2	101.3	101.0	102.1	100.2	100.9	101.4	100.7	101.0
98	Mar. 29, 1898	100.2	100.2	100.6	100.0	99.2	99.8	99.6	100.1	100.0
99	Sept. 3, 1897	102.2	101.0	100.6	102.8	100.9	101.9	101.7	102.1	102.1
99	Mar. 28, 1898	100.3	100.3	100.7	98.9	98.9	100.9	100.5	99.6	99.8
99	Sept. 4, 1897	101.9	101.9	101.6	102.0	101.2	101.9	101.9	101.9	102.0
99	Mar. 29, 1898	100.0	100.1	100.7	100.0	101.0	100.0	100.0	99.3	99.2
100	Sept. 3, 1897	102.4	101.3	101.7	102.2	102.1	102.0	101.9	101.9	102.0
100	Mar. 28, 1898	99.2	100.2	100.0	100.4	99.1	98.6	98.5	99.6	99.6
100	Sept. 4, 1897	101.1	101.5	102.2	102.3	101.5	101.2	101.5	101.6	101.1
100	Mar. 29, 1898	100.0	99.2	100.4	101.0	101.4	101.4	99.7	99.5	98.2

The spring temperatures are evidently lower than those taken in September. This may, of course, be due to other influences than atmospheric temperature, such as inactivity during the winter months, and the absence of flies during the winter months and March. The cattle cannot be said to have been inactive during March for they had enjoyed their freedom in a large lot, and appeared to exercise about as much, if not more than during the hot days of September. The flies may be instrumental in raising the temperature, yet it does not seem that they would make animal heat uniformly higher while the cows were stabled. Everything seems to indicate that this uniform reduction of temperature is to be found under the direct influence of atmospheric temperature. If this is true, changes in atmospheric temperature should be watched with great care. Whether the atmospheric temperature acts directly upon the animal or indirectly by the stimulation of some function, it would make little difference so far as the results are concerned. Instances have been cited me by Dr. Dunphey, State Veterinarian, where he has been entirely misled by the sudden change in atmospheric temperature.

DO LOWER OR HIGHER NORMAL TEMPERATURES OCCUR ON THE SECOND DAY THAN ON THE FIRST DAY OF THE TEST?

We shall select the normal maximal temperatures for two successive days just as in a test to determine the above question. The normal maximal temperatures are used in summing up results for judgment, consequently are peculiarly fitting for answering this question.

+Means higher maximal temperature on second day.

—Means lower maximal temperature on second day.

oMeans the maximal temperatures are the same.

No. of animal	16	2	23	22	69	67	59	77	82	78	74	79
	—	—	—	—	+	+	+	+	+	o	+	—
No. of animal			80	76	85	72	75	105	100	104	106	116
			+	+	—	—	—	—	+	—	+	o
No. of animal		98	96	87	108	107	88	99	97	109	110	111
		+	+	+	+	—	—	+	o	—	—	—
No. of animal		86	94	18	91	101	90	89	92	93	103	95
		—	+	—	+	—	+	—	—	—	—	—
No. of animal				39	128	127	44	125	43	123	126	124
				+	—	—	+	+	+	—	+	—
No. of animal				122	52	121	53	133	112	113	120	68
				—	+	+	+	o	+	—	+	—
No. of animal		114	117	119	70	115	118	14	13	15	11	9
		—	+	+	—	—	—	—	+	—	+	—
No. of animal	6	29	57	56	63	20	17	2	5	7	9	13
	—	—	—	—	+	—	+	—	—	+	o	—
No. of animal		14	16	17	23	44	52	53	59	75	86	87
		—	—	o	+	—	—	+	—	—	—	—
No. of animal		88	89	90	91	92	93	94	95	96	97	98
		—	—	—	—	—	—	+	—	+	—	o
No. of animal				99	100	101	103	104	105	106	107	108
				—	—	—	—	—	—	+	—	+
No. of animal						109	110	111	112	113	114	115
						+	—	+	—	+	—	—

Total number of comparisons of normal maximal temperatures, 123.

Total number of maximal temperatures where the second day exceeds that of the first, 44.

Total number of maximal temperatures where the first day exceeds that of the second, 72.

Total number of maximal temperatures where the first day equals the second day, 7.

This indicates that the temperatures run a little lower on the second day than on the first although it cannot by any means be depended upon.

TIME OF DAY WHEN THE MAXIMAL AND MINIMAL TEMPERATURES OCCUR.

This study does not include the twenty-four hours of the day, but is confined to those hours in which the temperatures are most likely to be taken. The normal temperatures alone are used.

The total number of temperatures during the given hour is found, then the number of maximal and minimal temperatures occurring during that hour. By following this method a fair idea of the hours, in which the maximal and minimal temperatures are to be found, can be obtained.

March 28 and 29, 1898.				September 3 and 4, 1897.			
No. of temperatures taken.	Time.	No. of maximal temperatures occurring.	No. of minimal temperatures occurring.	No. of temperatures taken.	Time.	No. of maximal temperatures occurring.	No. of minimal temperatures occurring.
98	7 a. m.	22	8	15	7 a. m.	3	2
195	8 a. m.	63	34	86	8 a. m.	13	17
196	9 a. m.	30	11	86	9 a. m.	3	11
196	10 a. m.	29	26	86	10 a. m.	2	24
196	11 a. m.	14	31	86	11 a. m.	7	16
196	1 p. m.	15	39	86	1 p. m.	5	15
196	2 p. m.	17	16	86	2 p. m.	6	2
196	3 p. m.	8	19	86	3 p. m.	13	4
196	4 p. m.	18	24	86	4 p. m.	22	3
196	5 p. m.	17	30	86	5 p. m.	27	3

It is readily seen that no reliance can be placed upon any hour as representing the highest number of maximal temperatures or minimal temperatures. Furthermore, there is a great difference in the relation of maximal and minimal temperatures in the two tests given. In March, the five o'clock hour has a larger number of minimal temperatures than maximal temperatures, while in September the order is strikingly reversed. This is more or less true throughout the table, no harmony prevailing at all. We cannot select any hour, therefore, with the hope of securing the maximal temperature and allow it to stand as a representative normal temperature. A large number of normal temperatures are required to give a satisfactory notion upon which to base judgment.

A RESPONSE TO TUBERCULIN.

We have placed the stress of our work upon normal temperatures, for they are in reality the foundation of interpretation. Knowing what the normal temperatures may lead to, any deviation from the normal may be more readily detected, but unfortunately our knowledge has not yet reached a point where absolute reliability is assured.

By a response to tuberculin or a reaction we understand that a rise of temperature has been produced by the injection of tuberculin in a tuberculous animal and that a febrile condition exists in the animal. It is this response to tuberculin which enables us to decide whether an animal has tuberculosis or not. Should there be the slightest rise in temperature or a very marked rise in temperature that is due to tuberculin, tuberculosis is probably indicated. On the other hand, a rise of temperature may occur from some other cause than tuberculin, when it is expected that it will result from tuberculin only. Our investigations thus far establish the possible variations which may occur in the normal temperatures from various unknown causes, consequently we are not in a position to state whether this rise of temperature is produced by tuberculin or by some other agent. Errors are likely to occur and will happen even to the extent, perhaps, of fifteen per cent. in some herds, but usually the errors will be much less. If a herd is to be freed from tuberculosis, the errors will have to be controlled by a cautious study of each animal's normal temperatures, and then, although the errors may be greatly lessened, a small per cent. will still persist.

There are characteristics which will assist us in deciding whether a rise of temperature is attributable to tuberculin:

First, There is a gradual rise of temperature beginning eight to sixteen hours after injection;

Second, This rise reaches the maximal point in a few hours, then gradually falls back to normal;

Third, This febrile condition persists through several hours;

Fourth, The extent of rise may be measured by one or more degrees which cannot be fixed and must be considered in connection with other features;

Fifth, There is sometimes an irregular febrile condition, which is difficult to interpret. This condition is more likely to take place in animals much advanced in tuberculosis, yet it is by no means generally true.

These statements are based upon the tables and are drawn from those numbers marked with a +. In reviewing the numbers thus marked it must be remembered that in some cases there is no reaction at all and that it means, the animal had once responded but had failed in that particular test, for it is established beyond dispute and long recognized that cattle will not respond to tests made every six months or every year, although they had reacted previously.

The errors which may creep in even by recognizing the above characteristics should be mentioned. Each characteristic is not infallible, it simply is the best guide we are able to give. Turn to Table XVI, Nos. 6 and 17, and there will be found what would be considered typical reactions. Others are present in the tables. Such "normal reactions" cannot be differentiated from "tuberculin reactions."

So far as a close analysis of reactions is concerned, it scarcely seems necessary to make one after the extensive study of normal temperatures, and the designation of reactions in the tables. If the temperatures before the injection of tuberculin are understood, the temperatures after injection will be easily interpreted.

TENTATIVE CONCLUSIONS.

1. Tuberculin is the best diagnostic known for tuberculosis.
2. Tuberculin itself may be infallible, but its application and interpretation are not.
3. An arbitrary point of condemnation is unwarranted.
4. To succeed in eradicating tuberculosis from a herd, the tuberculin test must be applied persistently at intervals for as yet an undetermined time.
5. The slaughtering of animals reacting to tuberculin is not justified, unless the physical condition of the animal confirms the tuberculin test and makes it a wise precaution. [Reacting animals should be isolated.] Should a second test diagnose tuberculosis, slaughter is possibly made justifiable unless the animal is sufficiently valuable to isolate for her offspring or in hopes of recovery.

I wish to acknowledge my great indebtedness to Prof. E. A. A. Grange for the most important part he has occupied in this bulletin and for his timely suggestions.

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SOME INSECTS OF THE YEAR 1897.

W. B. BARROWS AND R. H. PETTIT.

Bulletin 160.—Zoological Department.

INTRODUCTORY.

During the year 1897 the Zoölogical Department of the Experiment Station has received and answered many hundreds of inquiries relating to insects, some of which, although fairly common always and abundant occasionally, do not appear to be well known to the farmers and fruit-growers of the State. It has seemed best, therefore, to publish a few notes relating to certain of these insects, with the hope that such a bulletin many not only prove helpful at once to many residents of the State, but that its general distribution may lead to an increased correspondence and better acquaintance with the active agriculturists of the State, and to a better knowledge on our own part of the insect enemies of our crops.

Notes are given here of twenty-eight species of insects, but it must not be supposed that these are the only ones which have caused damage, or even the ones which have caused the most damage during the past year. More or less loss is occasioned every year by the Hessian-fly, the chinch-bug, the plum-curculio, the codlin-moth, the tent-caterpillar, the squash-bug, cut-worms, wire-worms, and a host of other common insects, no one of which is treated in this bulletin. It is impracticable to publish in a single bulletin a treatise which shall cover *all* our insect enemies, and the selection made here is believed to be the most serviceable, all things considered, that could be arranged at this time.

In this connection, a few words of advice to correspondents may not be amiss. Whenever information is wanted in regard to any insect, insect work, or insecticide, the proper person at the College to address is not anyone whom you may know personally, or by name or reputation, but simply "the Entomologist of the Experiment Station," Agricultural College, Mich. Inquiries addressed in this way are sure to reach this department directly and to receive attention at the earliest possible moment. If addressed otherwise, delay may occur for various reasons, and in some cases the loss of a single day might endanger an entire crop.

It is well to remember that the most careful description of an insect is seldom as good as the insect itself, while in most cases a mere fragment of the actual insect is better than a page or two of description. Therefore in writing for information about any insect always enclose a specimen if possible, no matter how common or well known you may believe it to be; and if no sample of the insect can be found, send a sample of its work. In sending specimens by mail, they should be sent in glass or tin if possible, and with some of their natural food if alive. Leaves and fruits wilt rapidly if enclosed in wood or pasteboard boxes, and are also very likely to be crushed or broken in transmission. Small tin boxes of any shape may be used, and it is well to put a slip of paper with the address of the sender inside the box, in case the outer wrapper should be torn off or defaced. If a letter is enclosed with the specimens, the whole package is subject to letter postage; if the two are sent separately, they should be addressed exactly alike, and the package of specimens should be marked with the sender's name and address *invariably*. Failure to attend to this simple rule has led to more disappointment and trouble than would be supposed. Rarely does a week pass when we do not receive specimens without letters, or letters without specimens which are said to have been sent; and it is no uncommon thing during the height of the season to receive half a dozen packages by the same mail and to be unable to decide which are the insects referred to in letters received at the same time. Always send insects alive if possible, but send in strong, tight boxes—insects need no air-holes whatever. Never try to kill scale insects or others by dipping in kerosene or other insecticide before mailing. Always state definitely what harm, if any, the insect is supposed to be doing, and whether it is abundant or scarce.

The bulletin is mainly the work of Mr. Rufus H. Pettit, the efficient Assistant Entomologist of the Station, and I take pleasure in acknowledging at this time his cordial and intelligent help in all the various functions of our several positions, and in expressing my satisfaction with the manner in which all his duties have been performed. I would also tender my thanks to Dr. L. O. Howard, chief of the Division of Entomology, of the United States Department of Agriculture, for the use of several electrotypes, credit for which is also given with each cut, and to Professor M. V. Slingerland of Cornell University for similar favors.

GRASSHOPPERS.

Melanoplus femur-rubrum and *M. atlanis.*

In spite of the wet spring weather, grasshoppers did considerable damage in the western part of the State. Numerous reports of invasions reached us, although in few cases was the injury great. Specimens of the hoppers sent from the infested districts proved for the most part to be *Melanoplus atlanis* and *M. femur-rubrum.* These are known as the lesser migratory and the red-legged locusts respectively. (Fig. 1.)

FIG. 1. Red-legged Locust (*Melanoplus femur-rubrum*).

The best known remedy for grasshoppers is fall plowing for the destruction of the eggs. Where this practice can be regularly carried on over large areas the grasshoppers are not likely to become troublesome, but there is always some stump-lot or neglected lane which would be difficult or impossible to plow, or else there is some farmer who will refuse to plow his land, and these lanes and unplowed lots will furnish places for the hatching of enough locusts to infest an entire neighborhood.

The eggs are laid in pods containing about twenty-five or thirty eggs. These pods are made of mucus, which is given out with the eggs during the process of laying and dries down hard, becoming brittle and impervious to moisture. The eggs are thus provided with a water-proof covering about three-fourths of an inch long and smaller in diameter than a lead-pencil. The pods are concealed in holes in the sod in which they were formed. These fragile little pods of eggs are open at the upper end, providing a place for the escape of the young locusts. Now if the sod be plowed under, most of the egg-pods are turned wrong side up, besides being buried so deep that the young locust will never be able to escape; then, too, many are broken, and moisture thus gains entrance and leads to the destruction of the eggs. It is likely, also, that the plowing will expose many to their natural enemies, such as birds, shrews, mice, etc. A good rolling after the plowing and dragging will pack the dirt so tight that very few will escape. To be of the most value, the plowing must be general; no strips along fences, no lanes of any size, and no clearings containing brush and stumps should be allowed to seed the rest of the farm. When it is absolutely impossible to turn the sod under in these places, recourse may be had to another remedy, viz., *poisoned baits.* Bran mixed with Paris green, using 1½ to 2 lbs. of the poison to 25 lbs. of bran, should be stirred up with water to the consistency of dough; sometimes cheap molasses is added to make it stick together better. This is made up into small balls and placed about the field. The greatest care must be observed for a long time after using these baits that no live stock or poultry be allowed to gain access, and if it is impossible to completely exclude them it is best not to use the baits.

Another plan, which is perhaps the most universally used because it can be employed after the young brood appears in the early summer, and also because it does not require the use of poison, is the hopperdozer (Fig. 2). This is a long, shallow pan of sheet-iron set on runners and having behind it a banner or sail made of canvas or muslin stretched on a wooden frame. The bottom of the pan is covered with rags or old carpet previously wetted with water. When all is ready a pint of kerosene is poured into the pan and distributed over the wet rags, and the banner of cloth is also moistened with kerosene. The dozer is then dragged on its runners over the field and the hoppers either jump in or try to jump over, in which case they strike the banner and fall back into the oil. A mere touch of the oil is certain death; it may take a minute if the insect falls directly into it, or it may take half an hour if the insect simply alights on the banner moistened with the oil; but no matter whether the insect dies immediately or requires a little time, he is sure to die eventually, as has been proved time after time. The great majority of the hoppers that jump into the pan jump out again at once, but they die just as certainly and almost as quickly as if they remained.

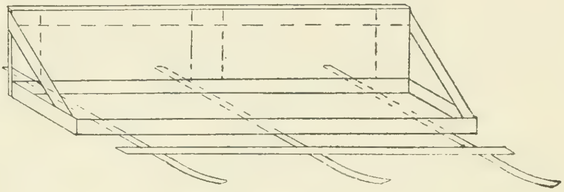
FIG. 2. Hopperdozer.

Hopperdozers are useful on open spaces only, and their size may vary from four feet long to about twenty feet. The shorter styles can be used to advantage in lanes and in places partially covered with trees or brush, and the longer styles on smooth, level plains. It is often found expedient to fasten two or three side by side, as they follow the inequalities of the ground more evenly than a single wide one. They can be used to drag around a field of grain, after cutting a strip wide enough to allow the dozer to pass, preventing in a great degree the migration of the grasshoppers into the grain. Grasshoppers do not like moisture, and they usually gather in the open spots when the dew is on the grain, to return when the warmth of the day has dried everything. At such times the hopperdozer is especially useful.

THE PEAR PSYLLA.

(*Psylla pyricola.*)

A pest on the pear which promises to become very serious has been found recently in considerable numbers in our State. According to Prof. Slingerland, this insect, the pear psylla, was probably first introduced into Connecticut from Europe in 1832. In 1838 it had spread over Massachusetts and part of New York. Since that time it has extended to Illinois and was found in Michigan by Mr. Schwarz before 1891. Recently it has been found in Kent county, where it has done considerable damage.

INDICATIONS OF ITS PRESENCE.

The presence of this little pest is usually indicated by a general loss of vitality of the tree early in the season. The young shoots wilt and droop, and by midsummer most of the leaves and fruit fall from the trees. Another indication of its presence is the liquid called honey-dew, which is secreted in large quantities and which spreads over the branches and even falls from them in drops. This sweet liquid attracts many ants, bees, wasps, etc., and often supports a black fungus growth later in the season.

DESCRIPTION OF THE INSECT.

Although capable of doing incalculable injury because of the myriads which infest a single tree, the individual insects are very small, measuring less than an eighth of an inch when mature and considerably less in the immature stages. The young (Fig. 3) are at first yellow in color, afterward becoming spotted with reddish and black. These little fellows hatch from the eggs about the middle of May and immediately commence sucking the sap from the trees, usually choosing the sheltered

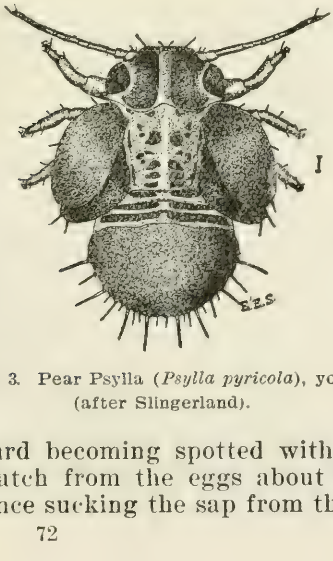

FIG. 3. Pear Psylla (*Psylla pyricola*), young (after Slingerland).

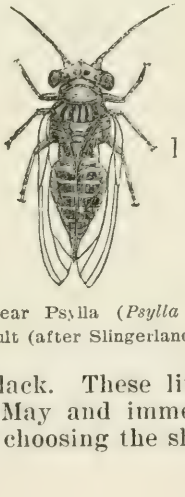

FIG. 4. Pear Psylla (*Psylla pyricola*), adult (after Slingerland).

place between the base or petiole of the leaf and the twig. Here they grow, and in the course of about a month change to the winged or adult form (Fig. 4). In this stage the insects have strong jumping legs and powerful wings, which enable them to escape when approached or when an attempt is made to spray them. Several broods are raised during the season, and the insect passes the winter either as an adult or immature.

While the pear psylla may be present for some time without a serious outbreak, it is certain to multiply to an enormous extent when all the conditions are favorable, and usually when least expected.

REMEDIES.

Most of the injury is done before the middle of June, and as the insects are destroyed most easily when in the immature stage, two or more *thorough* sprayings with kerosene-emulsion during the last week of May and the first week of June will so reduce the pests that very little injury is to be feared for the rest of the season. The emulsion should be made according to directions given in the chapter on insecticides, and should be diluted with fifteen times its volume of water. A winter wash of whale-oil soap undoubtedly would kill great numbers of the insects, which always pass the winter on the twigs and branches or in crevices of the bark.

Spraying at any time after the eggs hatch will prove beneficial, but experiments have shown that the best results may be obtained at the times indicated.

PLANT LICE OR APHIDS.

If there is any group of insects that requires the constant attention of nurserymen, green-house owners, orchardists and farmers, it is the family of plant-lice or aphids. The season of 1897 has been unusually favorable for these vermin, as is always the case when the spring opens moist and cloudy, with very little hot weather early in the season. Such widespread and well-known pests require very little description; their small, pear-shaped bodies, rarely exceeding one-quarter of an inch in size, with the slender legs and feelers, are known to everyone. The life-histories of these plant-lice are, however, not so well known, and in many cases they are as yet a mystery. Many species pass the winter in the egg stage, although a large number of species are not yet known to produce eggs. The "winter eggs," hatching in the spring, produce wingless females, which bring forth living young without the intervention of the male. In some cases these young produce in turn winged females, in other cases wingless females (but these, whether winged or wingless, have the same power of producing young without pairing), and in the great majority of cases, if not in all, this method of reproduction is carried on until fall. Then in some cases males and females are produced, which, after pairing, give rise to one or more eggs, which serve to keep the species over winter. In many instances, as with the black peach-aphis and the grain-aphis, the aphids themselves live over winter. In some cases, as in the case of the hop-aphis *(Aphis humuli)*, the winter eggs are laid on one plant (in this case on the plum), while the young migrate to some other plant in the spring. The hop-aphis migrates from the plum to hop-vines and passes the summer there.

Aphids are sucking insects, taking their food through a slender tube which is thrust deep into the tissue of the plant. For this reason any arsenical poison that may be deposited on the surface of the plant will do them no harm; they will thrust their beaks clear through the poison into the plant and will suck the sap from beneath the surface. To kill these little robbers it is necessary to use contact poisons, such as kerosene-emulsion, whale-oil soap, tobacco-water, Pyrethrum, or some application which kills by closing up the pores or by irritation, or else to use some vapor, smoke, or gas, such as tobacco-smoke or carbon bisulphid. In exceptional instances, as in the case of lice that live underground, it is necessary to use some special treatment.

APHIDS OF PLUM, CHERRY, AND APPLE.

(*Aphis prunicola*, *Myzus cerasi*, *Aphis mali.*)

During the spring and early summer, few days pass without bringing some inquiry as to the method of getting rid of the lice on one of these trees. As these three species of lice all yield to the same treatment, it seems expedient to discuss them together.

The apple-louse passes the winter in the form of an egg. These oval eggs are very characteristic; they are black in color after they have been laid for some time, and are usually crowded together in large numbers. These are very difficult to destroy, and thus far nothing has been found which will do any good without killing the tree as well. As soon as the buds burst in the spring, the young lice crowd on to them and commence to suck. They remain on the leaves for some time, but usually disappear in the early summer to reappear again in the fall at the time of depositing eggs.

The plum and cherry aphids differ in some respects, but the life-history in general is similar. They may be easily killed by a spray of kerosene-emulsion (Hubbard formula), diluting the emulsion ten times, or by a spray of whale-oil soap, using one pound of the soap to six gallons of water. In the case of the cherry-aphis it is best to apply it a little stronger, as this louse is able to stand more than the others. Tobacco-tea, made strong, is used by many with success, but whatever is used must be applied thoroughly, for each louse must be hit to be killed.

THE BLACK PEACH-APHIS.

(*Aphis persicæ-niger* Smith.)

Next to the San José scale, the worst enemy to the peach in our State is the black peach-aphis *(Aphis persicæ-niger)*. This dangerous pest was first recognized in Michigan during the year 1889 by Dr. Erwin F. Smith.* Like the wooly aphis of the apple, this louse does not confine its operations to the branches and trunk of the tree, but works on the roots as well. It may be found on almost any part of the roots, but seems to prefer the smaller rootlets, on which it gathers in great numbers. Its work on the branches and leaves, while of a very serious nature, is not so dangerous to the tree as that on the roots. Ordinarily the lice may be found on both leaves and roots at the same time, but they may confine themselves temporarily to either one, the proportion underground varying at different seasons and according to the character of the soil. Sandy soil seems to be favorable to the root-form, while stiff clay is less liable to harbor them, although they may become troublesome even in the stiffest clay soil.

The insect itself is a small black louse, either winged or wingless. The winged form is about one-twelfth of an inch in length and measures a little more than one-quarter of an inch across the wings from tip to tip. The wingless form is somewhat smaller. In color the insects are shiny black except on the under side, which is dark, shiny brown.

While this shiny black louse is easily distinguished from other lice infesting the peach, it is well with the aid of a microscope to examine the roots, when its presence is suspected, and if found there to send a quantity of specimens in a tight tin box to the consulting entomologist for accurate identification.

The effect of root-lice is apparent in the sickly appearance of the trees (Fig. 5). Their most serious depredations are committed on young trees, whose stunted or dwarfed and starved appearance first attracts attention. The leaves turn yellowish, usually become somewhat curled, and it is said that the general appearance is suggestive of the first stage of yellows. Of course the only real proof lies in finding the insect, either on the leaves or on the roots.

REMEDIES.

Unfortunately, as these lice live both on the leaves and on the roots, the work of extermination requires concerted action against them in both of these places. The leaf or aerial lice are easily disposed of by a spray of kerosene-emulsion (Hubbard formula), using one part of the emulsion to ten of water; or by a spray of whale-oil soap at the rate of one pound of soap to six gallons of water; or strong tobacco-water may be used in the form of a spray. The root-inhabiting form, however, requires a more laborious and expensive treatment. Probably the best remedy for root-lice is tobacco-dust. It must be *dust* and not merely waste or chopped tobacco, for experiments have proved that coarse tobacco is

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*Ent. Amer. 1890, pp. 101 and 201

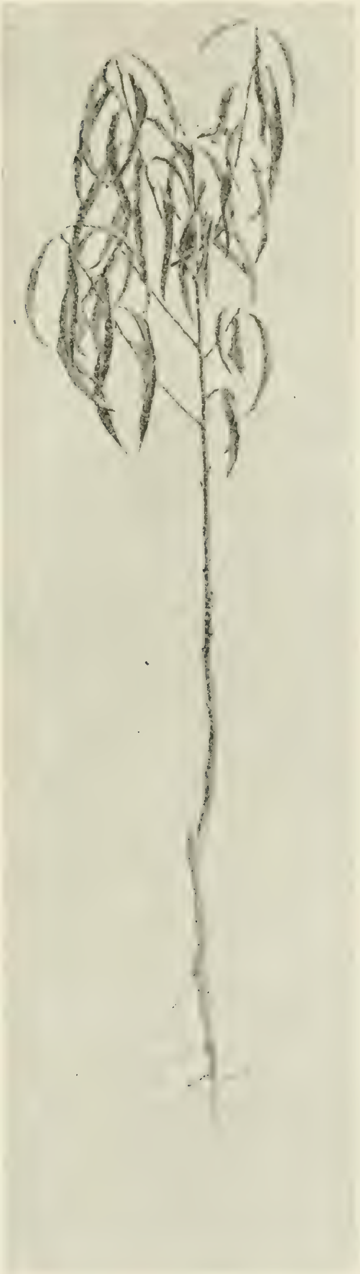

FIG. 5. Young peach tree affected with Black Peach Aphis (*Aphis persicæ-niger*). (Original.)

very inferior to dust, for the reason that the coarse particles require a good deal of time for the nicotine to leach out, preventing a thorough drenching of the roots with nicotine water all at once, as is the case where fine dust is used. The slower action of the coarse tobacco kills some lice to be sure, but much of the nicotine decomposes before it is extracted and the soil water never becomes strongly laden with the poison. The soil over the roots should be removed to the depth of several inches and the dust dug in about the roots, after which the soil should be replaced; or a trench may be dug around the tree at a distance of about two feet and then covered again after a liberal supply of the tobacco-dust has been put in. If possible this work should be done before a rain, but a thorough artificial drenching will answer the purpose. Tobacco-dust should cost one or two cents a pound, and it is worth that much as a fertilizer even if it were of no value on account of its insecticidal powers.

Another remedy said to be very useful is kainit. Prof. J. B. Smith of the New Jersey Experiment Station recommends it very strongly.* Kainit is a potash salt which is very efficient as a fertilizer. It should be used at the rate of about ten pounds to a five or six-year tree and may be spread on the surface of the ground over an area about as large as the roots are supposed to cover, care being taken not to let it come in contact with the crown, or in fact within several inches of it. Wood ashes used in the same way may also prove efficacious.

All stock purchased from places where this aphis is found should be carefully treated to destroy any lice or eggs that may cling to the roots. Strong tobacco-water is a safe and effective wash for this purpose. Whale-oil soap, using one pound of the soap to six gallons of water, will no doubt prove a useful and effective remedy. Hot water at 130° Fah. will also kill the lice without injury to the stock, if not immersed too long.

THE WOOLY APHIS OF THE APPLE.

(*Schizoneura lanigera.*)

Ranking about equal to the black peach-aphis is the wooly aphis of the apple. Both of these insects have root-inhabiting forms, which renders their extermination very much more difficult than in the case of species living only above ground. The wooly aphis takes its name from the secretion of wool-like flocculent matter covering its body. This wooly covering renders the lice very conspicuous when clustered on the branches of a young apple-tree. Large, knotty swellings are produced on the branches where the lice congregate, and smaller knots and swellings are produced in the same way on the roots (Fig. 6, *a*). The most serious injury from these wooly-lice is done to young stock, but larger trees suffer as well. When numerous on the roots, the latter become deformed and after a time rot, leaving the plant seriously handicapped for want of sufficient food and support. This fact makes itself apparent by the general appearance of the tree, which becomes sickly and may die finally. The cause of all this trouble is ordinarily easy to detect because of the appearance of the insects on the branches, where they produce knots.

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*Economic Entomology, p. 131.

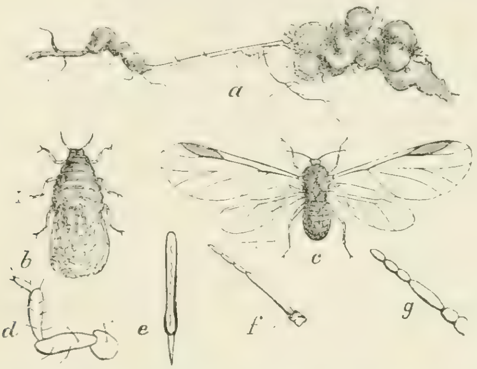

FIG. 6. Wooly Aphis of Apple (*Schizoneura lanigera*); *a*, galls caused by them on apple root; *b*, wingless, wax-coated form; *c*, winged form.

This insect has long been known in the east as a very destructive and important pest. It now exists in some parts of Michigan, but is not as yet widely spread over the State. Every precaution should be taken to prevent its further distribution, and where already established a strong effort should be made to eradicate it if possible. The same remedies that are recommended for the black peach-aphis will prove effective here.

SCALE INSECTS OR COCCIDS.

Few other families of insects present such an array of strange and varied forms as the family of scale-insects. In this family of anomalies the females are all blind, wingless, and many of them footless as well, while the adult males are provided with wings, feet, and eyes.

The family takes its name from the scale or covering with which most of its members are provided. Nearly all are small or minute insects, few exceeding one-eighth of an inch in size, while most of them are smaller still. The scale or covering serves the part of a tent or shield to protect its inmate. Among the different species this shield or scale varies greatly in size, color, and form, and in some cases is wanting altogether, but when present it consists of a thin, papery or waxy shelter raised at the center, something after the manner of a limpet, and concealing its inmate in the space thus formed. The cast-skins of the insect are usually borne on the top or at the end of the shield. A number of closely allied insects, that show close affinity on account of similarity of structure, are classed among the scale-insects although they are not provided with a separate scale.

The young of all these scale-insects are small oval lice, which run about freely for a short time. As they are very minute and active, they may easily pass on to the feet of birds and insects and be transported long distances by them, when, if they alight on their appropriate food-plant, the young scale-insects may start new colonies.

The young louse, after finding a suitable place, settles down and inserts its long, thread-like beak into the plant and abstracts its first meal. In some species the beak is never withdrawn, but the insect becomes attached to this place and never moves from it.

During the growth of the true scale-covered insect, the male sheds its coat twice and the female three times. The female loses legs and antennæ at the first molt and becomes a mere sac, with a long, hose-like mouth, capable only of absorbing food and getting ready to lay eggs. The fringe-like spinning apparatus by which the scale is secreted is situated at the rear end of the body, and by the arrangement of the different parts of this fringe the species are classified.

In due time the male changes to the pupal stage and developes wings, antennæ, legs, etc., but as its life is to be very short, it has no need for a mouth, and a second pair of eyes takes its place.

After the sexes pair the eggs are laid, the female gradually shriveling up and making room for them under the scale as fast as they are laid. The eggs hatch at various seasons, depending on the species. Some pass the winter in the egg state, while others winter in a half-grown condition and deposit the eggs in the spring. In some naked species not furnished with a true scale the eggs are laid under the body of the mother, which shrivels up as they are laid until finally she dies, leaving her shriveled skin as a shelter for her eggs until they hatch.

SAN JOSÉ SCALE.

(*Aspidiotus perniciosus* Comst.)

The most important insect pest of 1897 has been the San José scale. Although a single infested orchard had been found in 1896, the danger from the scale was not fully realized until recently, when a number of badly-infested orchards have been located.

Even at the present time (June, 1898,) the status of this pest in Michigan is by no means well known. The appointment of an "Inspector of Orchards and Nurseries" in September, 1897, led to some investigation as to its presence in various sections, but in order to comply with the provisions of the law relating to nursery stock the inspector was compelled to give practically his entire time to the examination of the stock of nurserymen and dealers, so that no inspection of orchards was practicable. In January, 1897, the addresses of more than 400 persons in Michigan were obtained who had received stock from infested nurseries in the east, and examination of less than fifty such cases revealed the presence of the scale in five. It was impossible for the department to investigate satisfactorily the remaining 350 or more cases, and although the recipients of suspected stock were all notified of the danger, and many of them have stated most positively that their places are entirely free from the scale, yet it is almost certain that the pest was introduced in some of these shipments and that it will be found eventually in some of these suspected localities. Already, almost by accident, it has been located at several places in the State not on the suspected list, and the origin of some of the worst cases of infestation thus far found is still unsettled. There can be little doubt that irresponsible dealers and careless agents in many instances have furnished infested stock to unsuspecting purchasers, and for this reason it may never be possible to trace the infection to its source.

It may or may not be possible to exterminate this pest as it is discovered, and to keep it out of the State hereafter, but unquestionably it is the duty of every loyal citizen to report at once the presence of any suspicious insect and to allow the most thorough investigation, so that in case of the actual discovery of the San José scale the best methods of combating it may be put in operation promptly and its spread and increase be immediately checked. While the State Inspector alone has full power to enforce treatment of infested orchards or stock, the Entomologist of the Experiment Station will be glad always to examine and name specimens of scale-insects or other insects of any kind, and to furnish directions for avoiding or fighting any or all of our insect pests. Address all queries relating in any way to insects or their work to "Consulting Entomologist, Experiment Station, Agricultural College, Mich.," and be sure in sending specimens that the name and address of the sender are written plainly on the package containing the insects, so that no confusion may be possible when (as often happens) several packages of insects are received by the same mail.

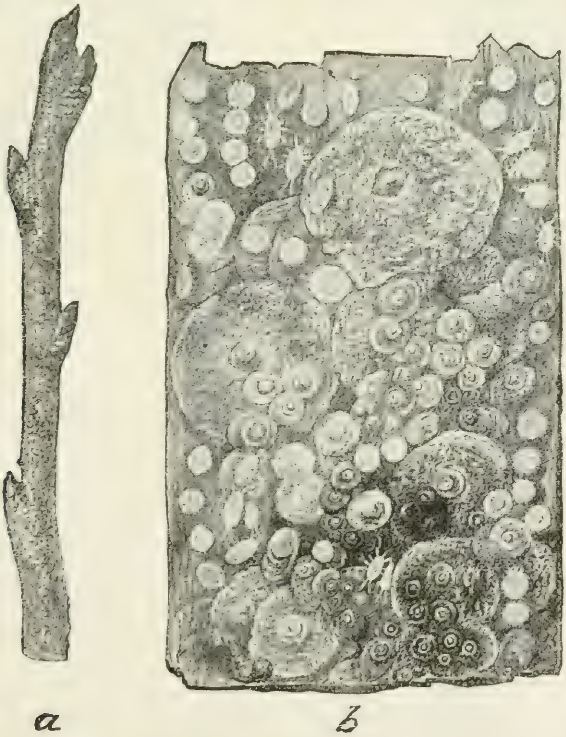

FIG. 7. San José Scale (*Aspidiotus perniciosus*); *a*, infested twig, natural size; *b*, bark as it appears under hand lens, showing scales in various stages of development, and young larvæ (after Howard, Bull. 3, New Series, Division of Entomology, United States Department of Agriculture).

The difficulty with which this species is detected is one of its worst features. The scales are so very inconspicuous that it is extremely difficult to find them before they have become so numerous that severe measures are required to check their increase and spread.

The appearance of this scale when in large numbers is that of a blackish grey scurfy deposit over the whole or any part of a tree (Fig. 7). When more closely examined, this covering is seen to be made up of myriads of small papery scales which can easily be detached by the thumb-nail, thus exposing the yellow or orange-colored bodies of the insects under them. These easily crush into an oily mass. The bark under and immediately around the scales is often stained wine-color, probably by some secretion or deposit of the insect. This, however, must not be taken as proof positive of the identity of the scale, for other scales closely resembling the one in question may produce the same effect. The individual scales are of two types, the scale of the female being several times larger than that of the male. The scale of the female (Fig. 8, *1*) is nearly circular and flat, with the exuviæ or cast skins of the larva in the center. It is grey in color, while that of the exuviæ varies from yellow to reddish-yellow or else is black. It measures one to two mm. (.04 to .08 inch). The scale of the male, on the other hand, is darker, usually almost black, and elongated (Fig. 8, *2*). The cast skin is usually black and appears as a tiny nipple-like prominence. The male scale is about half as long as the diameter of the female scale.

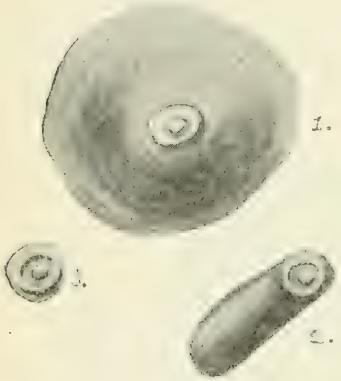

FIG. 8. San José Scale (*Aspidiotus perniciosus*).

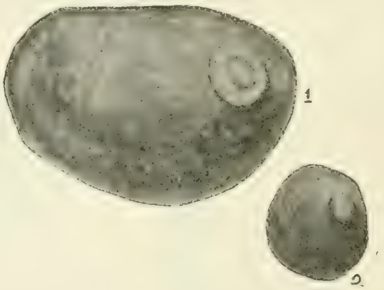

FIG. 9. Eccentric Scale (*Aspidiotus ancylus*)

These insects pass the winter in a partially-grown condition. At this time, before they become weatherbeaten and eroded, the scale shows a small central nipple surrounded by the slightly raised margin of the second larval skin, forming a minute elevated mound surrounded by a tiny ridge, the whole elevated and surrounded by the remainder of the scale, which varies in size according to the degree of maturity that it has attained.

As they are very small and dark in color at this time, the scales are naturally difficult to locate. This is readily understood if we remember that when a tree first becomes invaded there will be very few insects present, these only about the size of a small fly-speck and very likely placed under the base of a leaf. Only after they have become more or less numerous can they be found at all easily. The number of plants on which they can thrive renders their extermination still more difficult. The following is a list of their food-plants taken from a treatise[*] on this insect by Dr. L. O. Howard and C. L. Marlatt of the United States Department of Agriculture:

- *Tiliaceæ*
  - Linden
- *Celastraceæ*
  - Euonymus
- *Rosaceæ*
  - Almond
  - Peach
  - Plum
  - Cherry
  - Spiræa
  - Raspberry
  - Rose
  - Hawthorn
  - Cotoneaster
  - Pear
  - Apple
  - Quince
  - Flowering quince
- *Saxifragaceæ*
  - Gooseberry
  - Currant
  - Flowering currant
- *Ebenaceæ*
  - Persimmon
- *Leguminosæ*
  - Acacia
- *Urticaceæ*
  - Elm
  - Osage orange
- *Juglandaceæ*
  - English walnut
  - Pecan
- *Betulaceæ*
  - Alder
- *Salicaceæ*
  - Weeping-willow
  - Laurel-leaved willow

We have found it on grape also.

REMEDIES.

Numerous experiments have proved conclusively that the remedies found to be effective on the Pacific coast are almost useless in the east, and this seems to be due to a difference of climatic conditions. All the experiments tried in the east seem to indicate that a wash of whale-oil soap used at the rate of two pounds of soap to a gallon of water, is the best and cheapest remedy. This must never be applied except when the trees are dormant, for its effect is very injurious if used when the foliage is on the tree. Two applications should be made, one in the autumn just after the leaves fall and one during the winter. Too much stress cannot be laid on doing the work thoroughly; every spot and every twig on the entire tree should be thoroughly wetted.

Whale-oil soap costs about four cents per pound if purchased direct from manufacturer and in quantity; the cost is then eight cents per gallon for the liquid ready to spray. If purchased in small quantities, the cost is considerably more. Strong potash solution has been used to some extent, but thus far it has seemed inferior to the soap, while its cost is considerably greater. Kerosene-emulsion is inadequate, while pure kerosene is pretty sure to kill the tree.

Before spraying, it is best to cut back all that the tree will stand and to *burn the cuttings*. If a small amount of stock is found infested, it should be rooted up and burned.

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[*] Bull. No. 3, New Series, 1896.

THE ECCENTRIC SCALE.

(*Aspidiotus ancylus* Put.)

The nearest relative to the San José scale that we have in Michigan is the eccentric scale or Putnam's scale *(Aspidiotus ancylus)*. Indeed, the resemblance is so close that it requires a careful examination to discriminate the two species. The scale of the adult female (Fig. 9, *1*) is grey in color and nearly circular in form, though sometimes wider than long. The cast skins are almost always considerably to one side of the center or eccentric with the margin. The color of these cast skins or exuviæ is usually brick-red, though they are ordinarily obscured by a secretion which is formed over them. The scale of the female is from one mm. to two mm. in size. The male scale (Fig. 9, *2*) is smaller than that of the female and somewhat elongated, but otherwise resembles it.

The effect of large numbers of these scales cannot be otherwise than injurious, although trees seem to support a few without injury. The great range of food-plants on which the eccentric scale feeds makes it very difficult to eradicate. In this respect it is very like the San José scale. It is, however, an old stand-by; like the oyster-shell bark-louse, it has been here for a long time and is likely to be found on almost any apple, peach, plum or pear tree. It is also found on maple, hackberry, ash, and elm, besides a number of other trees and shrubs. Fortunately, although widespread, it is little to be feared, for it seldom becomes troublesome and then can be killed easily by the same methods employed against the San José scale.

The constant differences that distinguish the eccentric scale from the San José scale lie in the arrangement of the fringes on the last segment of the insect under the scale. These can be seen only with a compound microscope, and then the specimens require careful preparation. It is always best to resort to the compound microscope in settling these points, in order to be certain and to avoid the labor and expense which would follow the confounding these two species.

THE OYSTER-SHELL BARK-LOUSE.

(*Mytilaspis pomorum.*)

Perhaps no other insect has been received by mail in greater numbers during the past season than the oyster-shell bark-louse *(Mytilaspis pomorum)*. Although this scale without doubt has been a resident of Michigan almost from time immemorial, it has been brought to the front lately in unusual quantities because of its being mistaken for the San José scale. All scales look very much alike to the uninitiated and the oyster-shell scale is almost sure to be found wherever apple-trees exist. Fig. 10 will give an idea of the general appearance of the insect.

This scale, though everywhere present and sometimes very destructive, more often attacks trees that for some reason are unhealthy and which are therefore poorly fitted to support the extra drain of the scales. A strong, healthy tree can usually bear the presence of a few of these insects without much apparent injury, and they may be present for years in small numbers without multiplying sufficiently to do much injury. When, however, they become very numerous and seem to threaten the tree, they can be easily checked by a spray of whale-oil soap or potash, or by a spray of kerosene-emulsion when the newly-hatched lice are running about and before they have grown a covering for themselves. This time is usually during the last of May or the first of June,—the proper time can be exactly determined by closely watching the trees. Just as soon as the young lice are seen to be issuing from the scales it is time to spray. The young lice will appear as very small insects, about as small as can be seen by the unaided eye, and as they commence to secrete the scale almost immediately on coming out, the remedy must not be delayed. Use kerosene-emulsion, diluting about twelve times with water (Hubbard formula, or the same per cent of kerosene with any other formula). Another good practice is to scrape the scales from the limbs and then wash with kerosene-emulsion or strong soap solution.

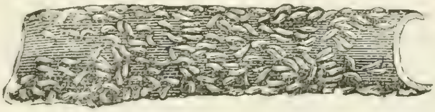

FIG. 10. Oyster-shell Bark-louse (*Mytilaspis pomorum*).

WHITE SCALE OF THE PINE.

(*Chionaspis pinifolii* Fitch.)

This pretty little scale is found on the leaves of almost all our species of pine and spruce. It is pure white except for the amber exuviæ at the base. The adult female scales are usually long and slender and measure about three mm. (⅛ inch). The males are somewhat smaller and possess only one cast-skin. While this scale does not often kill trees, it serves as a representative of the scale-insects, and is such a common species that anyone desirous of becoming acquainted with their appearance can readily obtain a supply.

SCURFY SCALE OF THE PEAR AND APPLE.

(*Chionaspis furfurus.*)

The scurfy-scale of the pear and apple can readily be distinguished from the other species likely to be found on the same hosts by its white color. It is from two to three mm. in size, and before it becomes corroded and soiled by the weather is snowy white except at the base, where the exuviæ are placed.

While by no means to be compared with the San José scale in destructiveness, it sometimes becomes numerous enough on small trees to do serious injury. It readily succumbs to the caustic and soap washes used against most of the scales.

THE PLUM SCALE.

(*Lecanium cerasifex* Fitch.)

During the past year several specimens of a scale-insect on cultivated plum have been received. These are undoubtedly the New York plum-scale *(Lecanium cerasifex* Fitch), which has been the cause of a great deal of loss in the eastern states. The scales (Fig. 11) are brown, hemispherical bodies about one-eight of an inch in length and with a dark brown, shiny surface, sometimes slightly wrinkled transversely. The longest diameter of the scale is usually placed lengthwise of the twig. During the early summer these scales are soft and easily crushed into a mass of pulpy flesh, but by the middle of June they become hard shells of a papery or horny texture and are then nearly full of eggs, which have been laid by the mother insect under her own body. The number of eggs under each scale is estimated at between one and two thousand. During July the tiny lice which emerge from the eggs make their way to the under side of the leaves, where they at once commence to suck the sap. Here they remain until late in August, when they migrate to the twigs, where they pass the winter. In this stage they are soft-bodied and less protected than at almost any other stage in their existence. Only one brood is hatched during the year.

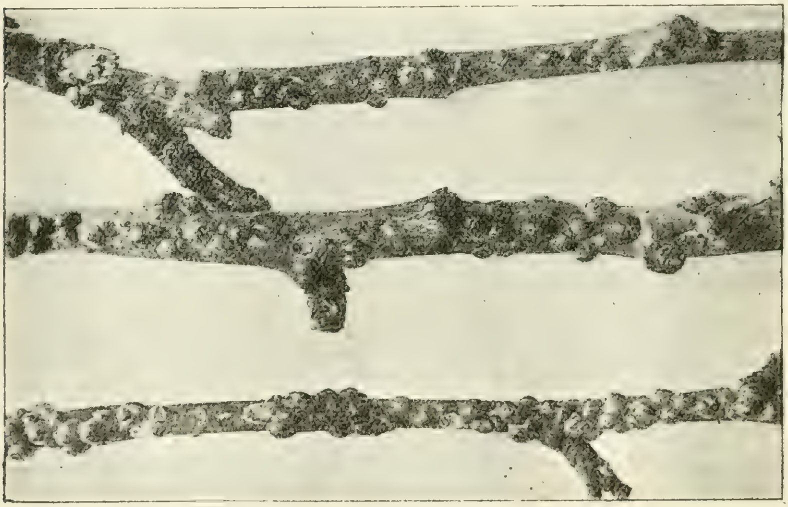

FIG. 11. Plum Scale (*Lecanium cerasifex*) (after Slingerland).

The importance of applying remedial measures against this pest wherever it is found cannot be too strongly urged, for although it may remain for a long time without multiplying injuriously, it is liable, like the pear psylla, to become very troublesome when the conditions for its rapid increase become favorable. The fact that it is a conspicuous, stationary insect that has no power of flying away just when we want to treat it, is greatly in favor of the plum grower.

REMEDIES.

In New York state, where the pest has been most destructive, it is found that a spray of strong kerosene-emulsion will kill them. Prof. Slingerland says:*

"Spray infested trees once after the leaves fall in the autumn, and at least twice in the spring before the buds open. Use kerosene-emulsion diluted four times (Hubbard formula), and the application cannot be done too thoroughly; each little scale must be hit."

CURRANT SCALE.

(*Lecanium ribesii* Fitch ?)

On April 12 a branch of currant covered with soft, fleshy scales was sent us from near Port Huron. The specimens seem to agree very well with the meager description of *Lecanium ribessi* Fitch.†

They are yellowish-brown in color, mottled with brownish-black, and the entire surface is covered with dirty-white pustules. A prominent longitudinal ridge, amounting almost to a carina, runs down the center for half the length of the scale. The adult female measures from one-eighth to three-sixteenths of an inch in length and the breadth is usually about two-thirds of the length. Fig. 12 shows a group of the scales, greatly magnified, on a twig.

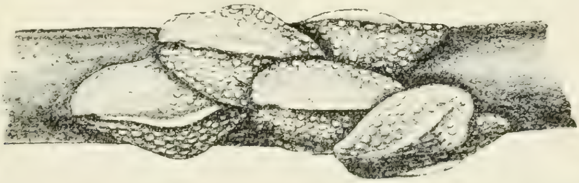

FIG. 12. Currant Scale (*Lecanium ribesii* Fitch) enlarged. (Original.)

While this scale has not done any great damage during the past season, the fact that it feeds on the currant and that it has been known to become destructive by reason of its rapid increase under favorable conditions, makes it of enough importance to bear careful watching. A thorough spraying with strong kerosene-emulsion during the early spring months will undoubtedly prove effective.

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*Bull. 108, Cornell Exp. Sta.

†"Third Rep. on Injurious Insects of New York, p. 109."

THE CANKER-WORMS.

(*Anisopteryx pometaria* and *Paleacrita vernata.*)

Very destructive insects are the canker-worms. Though easy to conquer if properly treated, the annual loss due to their depredations in our State is very considerable. The past season has been no exception to the general rule, for the insect has been present in destructive numbers in various parts of the State. To judge from the letters inquiring for remedies against this old-time pest, it would seem that many persons have yet to learn the methods of fighting it.

There are two species of canker-worms more or less common where-ever apples are raised; the fall canker-worm and the spring canker-worm. The fall worm (Figs. 14, 15) is perhaps the more common; it is a single-brooded insect, which lays its eggs either late in the autumn or early in spring. The egg hatches out a small loop-worm that grows to the length of nearly an inch. It varies greatly in color, but is usually grey or almost black, striped with yellowish or greenish. Being a measuring-worm, it has less than the ordinary number of legs, six true legs near the head and four false legs near the posterior extremity, with an extra rudimentary pair on the fifth abdominal segment. When full-grown it descends to the ground and usually buries itself, sometimes several inches beneath the surface. Here it forms a cell by turning round and round, and changes to the pupal stage. Late in the fall, from the last of October to the time when the ground becomes frozen, the adults emerge and lay their eggs on the branches of the trees. Many of the moths do not emerge in the fall, but remain in the ground till spring. When adult, the two sexes differ greatly in appearance. The male is a pretty moth with ash-grey front wings marked by three transverse darker lines, and hind wings of silvery grey (Fig. 14, *a*). The female, on the other hand, is not provided with wings, but has to crawl wherever she goes. She is somewhat more robust than the male and ash-grey in color, marked with black (Fig. 14, *b*).

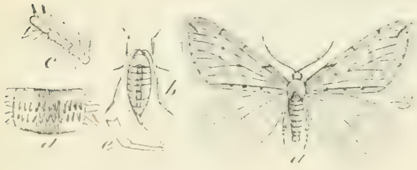

FIG. 14. Fall Canker-worm (*Anisopteryx pometaria*); *a*, male; *b*, female; *c*, *d*, *e*, structural details.

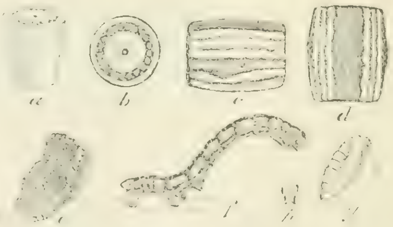

FIG. 15. Fall Canker-worm (*Anisopteryx pometaria*); *a*, *b*, egg, enlarged; *e*, patch of eggs; *c*, *d*, body segments of; *f*, larva; *g*, pupa of female.

The life-history of the spring canker-worm conforms in most important particulars to that of the one described, except that the adults do not come out till spring. The loopers or span-worms of this species lack the pair of rudimentary legs on the fifth abdominal segment (Figs. 13, 16).

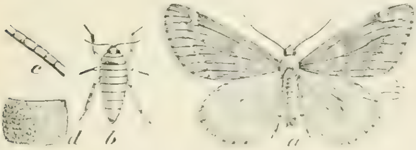

FIG. 13 Spring Canker-worm (*Paleacrita vernata*); *a*, male; *b*, female, *c*, *d*, structural details.

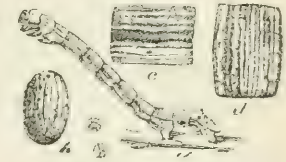

FIG. 16. Spring Canker-worm (*Paleacrita vernata*); *b*, an egg, much enlarged; *c*, *d*, body segments of larva.

REMEDIES.

The fact that the female canker-worms are wingless and must creep from the ground to the branches of the trees in order to lay their eggs, gives us an excellent means of fighting them. If we can head them off and prevent them from crawling up the trunks of the trees, the eggs cannot be deposited on the twigs and no harm will result. To accomplish this end various devices have been tried, such as banding the tree with paper and on this spreading printer's-ink or caterpillar-lime, or anything sticky enough to prevent the caterpillars from crawling up. Perhaps the best band is made of cotton-batting; a strip of this is wound around a tree trunk and fastened securely by a string at or below the middle. The upper end is now turned down, forming a loose, fluffy mass, in which the insects get entangled and die. This method has one disadvantage; the bands have to be kept on from the last of October until spring is well advanced, and must be renewed after rains, or when the cotton loses its fluffy nature. As the worms feed upon apple, elm, cherry and some other trees, precautions must be taken to prevent them from breeding on these trees and again infesting the fruit-trees.

The best method of overcoming these pests, however, is by spraying. They readily yield to a spray of one of the arsenites (see chapter on insecticides), which should be applied early, as soon as any worms are seen, even before blooming, but never during the period of bloom. It may be necessary to repeat the spraying, but this method is by far the cheapest and most satisfactory.

THE APPLE-LEAF TYER.

(*Teras minuta cinderella* Riley.)

In 1872, Dr. Riley described a small leaf-tyer *(Tortrix cinderella)** on the apple. Since that time, while it may have become injurious occasionally, it has never gained the name of a dangerous pest. The season of 1897 has witnessed an outbreak of this disease on the apples and pears in the southeastern part of the State.

The insect usually makes its presence known by folding together the upper surfaces of the leaves of the apple and pear along the midrib and then fastening them by means of silk. Inside this folded leaf the little worm lives and eventually passes its pupal stage preparatory to coming forth as an adult. The larva or caterpillar is about one-half an inch long, yellowish-green in color, with the head and neck yellow and darker, the head marked with a crescent-shaped black spot. The pupa is about one-third of an inch long, brown, with a rounded knob-like projection in front of head. The adult is ash-grey in color, the front wings deeply colored and glossy, with a few reddish scales scattered over them sparingly and not giving the appearance of spots. The hind wings are of the same color but lighter, with a narrow fringe. The wings spread about one-half an inch.

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*4th Mo. Rep., pp. 46-47.

Our attention was called to this insect by Prof. U. P. Hedrick, then State Inspector of Nurseries and Orchards, who sent us specimens and who kindly furnished us with the result of his observations. In the southeastern part of the State the leaves folded by this insect were numerous and the damage considerable, but as yet we have not heard of it from any other part of the State.

Several parasites are known to infest the leaf-tyer, and Prof. Hedrick assures us that he has seen flocks of blackbirds (probably the rusty grackle) feeding on the pupæ, neatly picking them out of their shelters and destroying them so completely that it was impossible to procure a good set of specimens.

When it becomes necessary to destroy these leaf-tyers, it can be accomplished by repeatedly spraying with Paris-green when the larvæ are very young. See chapter on insecticides.

THE BUD-MOTH.

(*Tmetocera ocellana.*)

Early in spring, just as they commence to swell and open, the buds of the apple, pear, plum, cherry, quince and peach-trees are sometimes attacked by a small, naked caterpillar about one-fifth of an inch long and dirty white in color. The head and thoracic shield are black or very dark brown. These caterpillars voraciously devour the opening buds and later feed on the tender leaves, binding several of them together at the end of a shoot. In this nest the caterpillar lives and feeds, after a time attaining half an inch in size. Specimens sent us from Bad Axe, Mich., and placed in breeding-cages, became full-grown about June 11. On June 15, they pupated inside the nest of leaves. On June 28, they commenced to emerge as ashy-grey winged moths, expanding about three-fifths of an inch from tip to tip of their wings. This delicate little moth (Fig. 17) is very prettily marked near the center of each fore-wing with a large, ill-defined creamy spot, while the base and tip of the wing are marked with black and dull blue. The hind-wings and the abdomen are grey. According to Professor Slingerland,* the moths lay their eggs three or four days after emerging, usually on the under side of the leaves. They are described by him as transparent, flat,

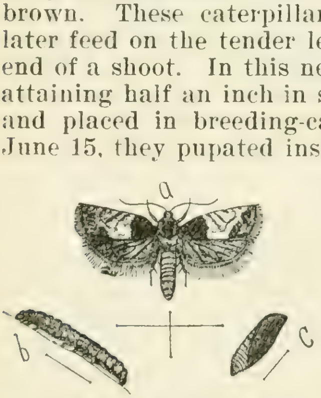

FIG. 17. Bud Moth (*Tmetocera ocellana*); *a*, moth; *b*, larva; *c*, pupa.

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*Bull. 50, Cornell University Ag. Exp. Sta., March, 1893, being a detailed history of the Bud-moth and its ravages.

disk-like bodies, oval and very small. The egg stage is said to last from seven to ten days. The little caterpillars immediately commence to eat the outer covering of the leaves, usually on the under side, leaving the skeleton of veins untouched. The young larvæ spin a delicate tube of silk, in which they live. When they are grown to about one-fifth of an inch in length, they spin a tube in some protected place on the bark, and in this pass the winter. In the spring they come out and attack the bark as described.

REMEDIES.

The bud-moth may be destroyed most easily at the time when it first attacks the buds in spring. Prof. Slingerland says:*

"Undoubtedly it can be checked somewhat by spraying in July, when the larvæ are at work on the under side of the leaves, but the time to combat the pest most profitably and successfully is in the spring when a little poison can easily be sprayed upon the opening buds; and thus the little larva, hungry from its long winter's fast, will be quite certain to get the fatal dose at its first meal."

This spraying should be repeated several times, as the period during which the insects can be reached is a short one, and they do not all come out together. The opening buds should be kept thoroughly poisoned, and the trees should be sprayed once or twice after the blossoms fall.

THE ARMY-WORM.

(*Leucania unipuncta.*)

The first recorded army-worm invasion in the United States took place in 1743, and from that time to the present we have been subject to greater or less loss from this source. During the past summer several complaints have been received from residents of the northern part of this State, and while the damage has not been so very serious to the State as a whole, it has caused some loss to individuals. The eggs of this well-known depredator are laid on the leaves and stems of grasses and grains. The young cut-worms that hatch from these eggs soon commence to cut off the leaves of their food-plants after the manner of other cut-worms, for the army-worm is really a cut-worm which has the habit of breeding in great numbers in a restricted area.

These little worms work mainly at night and during cloudy weather, and after cutting off a number of leaves and allowing them to wilt, they descend and eat, hiding during the day. After a time the leaves are all eaten and the hungry caterpillars are forced to attack the heads. It is at this time that the farmer usually first notices them. On looking into an infested field of oats or wheat before the tops are cut off all the stems are seen to be bare, making it possible to see for some distance into the grain, and if one kneels down and looks below the level of the heads the stems appear like a forest of minature fishpoles. As the worms usually appear by millions and all mature about the same time, the cutting off of the heads usually occurs very rapidly, so that in two or three days large fields that apparently had been in fine condition are destitute of heads. Now commences the march that gives the name to the army-worm. As if moved by a common impulse, the hungry worms move off rapidly, usually all going in nearly the same direction. In this march they take almost anything that presents itself; many weeds, almost all grasses, many garden vegetables, corn, flax, etc., devastating the section through which they march much after the fashion of a small army. After a few days they become full-grown, if well fed, and pass into the ground, where they change to light-brown pupæ just beneath the surface, the insects remaining in the ground as pupæ for a time varying with the season and the brood. After a time, however, the pupæ split down the back and from each issues a moth, which after mating proceeds to lay a liberal supply of eggs for the next brood.

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*Bull. 107, Cornell University Ag. Exp. Sta., January, 1896

In our State there are probably three broods—one in April or May, one in July, and one in September. The second brood, however, is the only one that is to be feared ordinarily. The first or May brood consists of those that have succeeded in passing the winter successfully, and their progeny. It is usually a small brood, and while it may do considerable damage here and there, it seldom assumes the size and habit of marching characteristic of the army-worm at its worst. The second brood, which ordinarily appears in July in our State, is usually the destructive one, while the third brood rarely becomes troublesome. Although the majority of the insects develop with these large broods, a varying number are to be found in any stage at almost any time after the snow is gone until quite late in the fall. While the great majority of the September brood pass the winter as pupæ, a number progress still farther and hibernate as adults, while some of their eggs hatch, producing young caterpillars, which pass the winter in a partially grown condition. Thus we may find larvæ or caterpillars, pupæ, and adults all hibernating at the same time.

The egg of the army-worm is very small, rounded and nearly smooth. The caterpillar which comes from it, although the individuals vary greatly, is brown with longitudinal stripes running along the sides. In typical specimens, the under side is yellowish-gray and the back gray, mottled very finely with dark brown. The sides are marked with three stripes running the entire length of the body. The middle one is dark brown, while those above and below are light yellow with mottles of red and with creamy margins. The head is yellow, covered with characteristic dark brown or black mottlings. The legs are sixteen in number; six true legs near the head and ten false legs or pro-legs ranging from the middle of the body to the posterior end. This caterpillar when full-grown (Fig. 18b) measures one and one-half inches in length. The worms

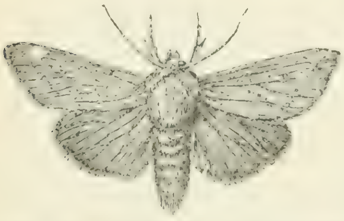

FIG. 18a. Army-worm (*Leucania unipuncta*).

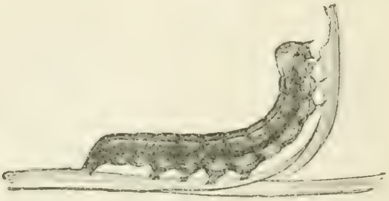

FIG. 18b Army worm (*Leucania unipuncta*)

on attaining their full size transform to the pupal stage; to do this they either go just beneath the surface of the ground or secrete themselves under rubbish, The pupa is brown in color and about three-fourths of an inch in length.

The adult winged-moth (Fig. 18a), the parent of the caterpillars, is a clay-colored "miller" about an inch long, having at the center of each front-wing a distinct white spot. The veins and margins of the hind-wings are slightly darker and the front-wings are sprinkled with dark scales.

NATURAL ENEMIES.

Fortunately the army-worm has many insect enemies that feed on it. Several flies belonging to the Tachinidæ and some little, wasp-like insects belonging to the Hymenoptera. The good work done by these insects has much to do with keeping down the ravages of the army-worm. The tachina-flies lay little china-like eggs on the skin, usually near the neck, and these eggs hatch into grubs that burrow in through the skin and feed on the body of the living host. Whenever these eggs are seen to be plentiful, it is a pretty good sign that the worm will soon be in subjection again.

REMEDIES.

While it is difficult to apply any remedies that will save the field already infested, it is usually possible to prevent the migration into hitherto uninfested fields. To this end the entire infested area should be enclosed, either by barriers, ditches or furrows. The cheapest method and the one most quickly applied, is that of plowing furrows around the infested region. Four or five deep furrows should be plowed about six feet apart, turning the furrow toward the worms. The land side of the furrow should then be straightened with a shovel, and sometimes it is found advantageous to dig pits at intervals along the line, or better, to dig steep holes with a post-hole digger at intervals. The caterpillars in trying to march, will fall into the furrows, and in trying to climb up the steep side they will work along until they fall into the pits. Many will climb up the steep side of the furrow, but these will encounter the second ditch, and so on. When the first few ditches get well filled, they may be turned under by another furrow. As the worms work most in the night and during rainy weather, it is well to have several furrows where practicable, so that they will not require such constant watching. Sometimes the nature of the ground or of the surroundings renders it impossible to plow more than one furrow. In such a case a post may be attached to a rope and dragged along the furrow as the worms collect, crushing the worms and smoothing the furrow.

It is very difficult to say with any degree of certainty just when army-worms will become troublesome, but outbreaks are usually preceded by a wet spring, and two army-worm years seldom come in succession. It is well to watch the grain fields carefully, and whenever the leaves are seen to be disappearing and the little caterpillars are found to be plentiful, the field should be destroyed before the caterpillars are large enough to migrate.

THE ERRATIC ARMY-WORM.

(*Noctua fennica* Tausch.)

Every season or two, some insect long supposed to be harmless, and usually to be found at almost any time, will become a menace to farmers on account of changing its food-plant or by suddenly multiplying to unheard of numbers. The damage at such times may be considerable, but usually the insect quickly relapses to its normal condition and numbers, being held in check, perhaps, by adverse circumstances, or by parasites, until the proper combination of circumstances occurs again. The erratic army-worm has twice before become injurious under circumstances similar to those of 1897.

On May 21, a letter was received from Mr. W. S. Carpenter of Menominee, Mich., stating that the army-worms were eating his clover, and as he understood that army-worms did not ordinarily eat clover, he desired an explanation. The specimens sent a few days later were immediately recognized as the young of *Noctua fennica*. They were velvet-black in color, with a number of longitudinal yellowish lines and a brownish head (Fig. 19b). When full-grown they measure nearly one and one-half inches in length. These insects did considerable damage in the vicinity of Menominee, eating almost everything and even gnawing the bark from young trees. The specimens sent us went into the ground and became pupæ on June 10. They should have emerged as moths in a few days, but they all died. The moth is shown in Fig. 19a. While this insect is not known to have the habit of marching in armies, it may be destroyed in the same manner as is the true army-worm.

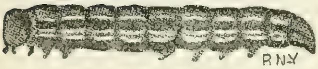

FIG. 19b. Erratic Army-worm (*Noctua fennica*).

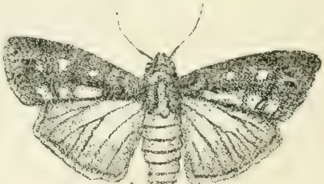

FIG. 19a. Erratic Army-worm (*Noctua fennica*).

THE ZEBRA-CATERPILLAR.

(*Mamestra picta* Harr.)

On July 13 the farm of Mr. Banghart, near Lansing, was visited, and complaint was made at the time that worms were eating his sugar-beets. The caterpillar was *Mamestra picta* (Fig. 20), and the effect of its ravages among the sugar-beets was very apparent. This worm is about two inches long, light yellow in color, with three broad, black, longitudinal stripes running the entire length of the body, these stripes transversely veined with white. The moth (Fig. 20) has dark chestnut front-wings and lighter yellowish hind-wings. The winter is passed in the pupal stage.

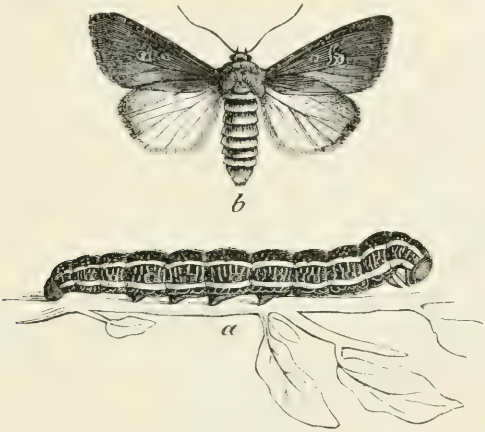

FIG. 20. Zebra-Caterpillar (*Mamestra picta.*)

REMEDIES.

Fortunately, this worm can be destroyed by several methods, which can be varied to suit the requirements of any particular case. When the plants are young and there is no danger in the use of poisons, Paris-green may be used, either as a spray or mixed with flour or plaster. After the plants have become larger and there may be danger from the use of arsenites, then a spray of kerosene-emulsion or a dusting with hellebore or Pyrethrum will do nearly as well. Hand-picking is effective on a small scale.

THE CAT AND DOG FLEA.

(*Pulex serraticeps.*)

There are several species of fleas that may infest houses and become troublesome. The species, however, usually found in this State is the common cat-flea or dog-flea *(Pulex surraticeps)*. The eggs of these tormentors are laid in the hair or fur of the cat or dog and usually fall to the ground or floor. Here they hatch into slender white, worm-like larvæ, which grow for a time and then spin a tiny cocoon, in which they pass their pupal stage. From one of these cocoons the full-fledged flea emerges in a short time. Now a single small dog will sometimes scatter a most surprising number of eggs. Professor Verrill tells of collecting a full teaspoonful of these eggs from the dress of a lady in whose lap a kitten had been held for a short time. In rearing fleas, one can usually obtain a supply of eggs by shaking some rug on which an infested dog has lain. These eggs get into moist cracks in the floor and find here the best conditions for development, with the natural result that the house is soon overrun with fleas.

During August, last, one of the hotels in the central part of Michigan was suddenly overrun, in certain parts, with fleas. Specimens of these proved on examination to be the dog-flea, as was expected. We advised the free use of Pyrethrum or Persian insect-powder (see chapter on insecticides), both on the dog and on the floors of the rooms infested. This was applied with a bellows, and inside of a week no fleas were to be found, though the treatment was continued for some time. The source of infection must be removed by rubbing Pyrethrum into the fur or hair of the animal, while the fleas in the room can easily be destroyed by means of a simple insect-powder bellows.

THE GRAPE CANE-BORER.

(*Amphicerus bicaudatus* Say.)

During the spring months the young shoots of grape-vines, as well as those of apple, pear, peach and plum-trees, are often found to be dying back for several inches from the tip. Occasionally this dead wood extends back for a foot or more. An examination of such twigs sometimes reveals a smooth, round burrow, extending several inches from the neat opening, which is usually placed in the axil of a bud (Fig. 22). This is

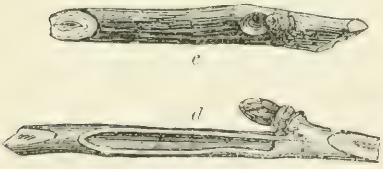

FIG. 22. Work of Grape-vine Cane-borer.

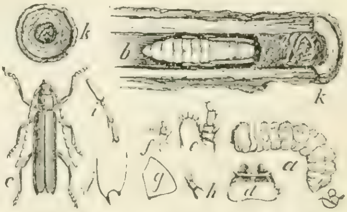

FIG. 21. Grape-vine Cane-borer, (*Amphicerus bicaudatus*).

the work of the apple-twig borer or grape-cane borer *(Amphicerus bicaudatus)*. On opening one of these burrows, it is sometimes possible to find the culprit, a slender, cylindrical beetle of dull brownish color (Fig. 21). The insects are always in the adult state when thus found, for their earlier stages are passed in quite different quarters. The damage done by these tunnelings is sometimes very serious, though what object the beetle can have in thus boring into the healthy growth is still a question; it is doubtless partly to obtain food. According to Mr. Marlatt,* the insect breeds in decaying and diseased wood and in old canes and prunings. It also breeds in briers, producing one brood a year. Mr. Marlatt recommends the removal and destruction by fire of all prunings and decaying wood from the vicinity of the vineyard before midsummer. It would be well, also, to remove all briers from the vicinity. When the insects once get a start, nothing seems to stop them except hand-pruning of all infested shoots.

CHERRY-LEAF BEETLE.

(*Galerucella cavicollis* Lec.)

The red cherry-leaf beetle (Fig. 23) *(Galerucella cavicollis)* furnishes an excellent example of the change of habit or of food-plant sometimes adopted by insects. Up to a few years ago the species in question was believed to feed exclusively on wild cherry, with the exception of having been found once or twice on buttercup and chestnut, but quite recently it has taken a liking to our cultivated cherry-trees, and on account of this change of taste has become a troublesome and destructive pest.

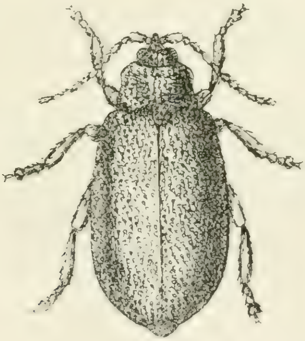

FIG. 23. Cherry-leaf Beetle (*Galerucella cavicollis*). (Original.)

In the Report of the Michigan Board of Agriculture for 1894, Mr. G. C. Davis mentions it as having been destructive to cherry-trees at Bellaire, Mich. It has lately become destructive in New York, and may soon be one of the regular enemies of the cherry.

The insect is thought to be one-brooded, and the beetles, which become troublesome in May and June, are probably those that have hibernated or passed the winter in some protected place. These adult beetles lay eggs, which hatch and commence to be noticed in July as grubs feeding on the cherry leaves. They pass the pupal stage in the earth and become adults in September, remaining in this stage until the following spring.

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*Year Book Dep't of Ag. for 1895, p. 391.

REMEDIES.

The best remedy is a spray of Paris-green, applied as directed in the chapter on insecticides, but this must not be used after the fruit is well set and before it is picked. During this period it is necessary to use some contact poison, such as whale-oil soap or kerosene-emulsion, and the soap solution, used at the rate of one pound to five gallons of water, will probably prove the cheapest and best remedy, for at this time the insects are in the larval stage and no doubt will readily succumb to the spray.

THE ASPARAGUS BEETLE.

(*Crioceris asparagi* Linn.)

As long ago as 1856 the asparagus beetle is supposed to have been introduced into America from Europe. Its first appearance was at Astoria, N. Y., near New York city. Since that time it has spread through most of the eastern states. Michigan has been fortunate to escape the depredations of this insect up to the summer of 1896, when it appeared in Berrien county. The past season has brought several complaints of its presence and injuries from that district. This pretty little beetle lives both in the larval and in the adult stage on the asparagus, both wild and cultivated, and both young and old.

The elongated eggs, about one-tenth of an inch in length, are placed in short rows on the plant and hatch in about eight days. The soft, gray grubs (Fig. 24d) coming from these eggs immediately attack the succulent leaves or stems and continue to feed for about two weeks, after which they go into the ground and become pupæ. Here they remain for about

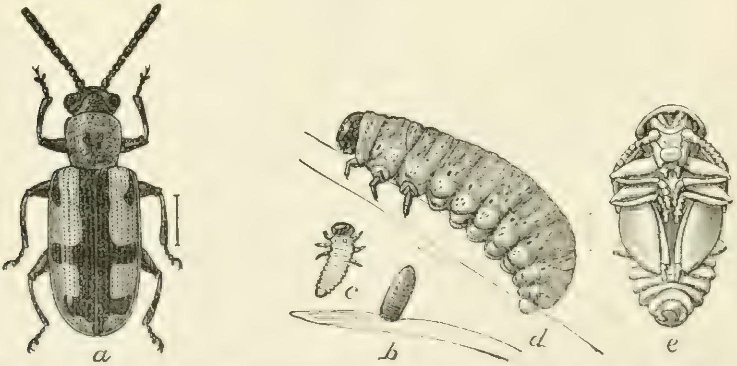

FIG. 24. Asparagus Beetle (*Crioceris asparagi*): *a*, adult beetle; *d*, larva, full-grown; *c*, young larva; *b*, egg; *e*, pupa, (Chittenden, Year-book of Dept. of Agriculture for 1895.)

eight days and then emerge as adult beetles. The entire time required from the laying of the egg to the appearance of the adult is about a month. The winter is passed by the adult under rubbish, loose bark, etc. The adult beetle (Fig. 24*a*) is about one-quarter of an inch in length, the wing-covers are reddish-yellow and cream color marked with black. The head is black and the thorax reddish-yellow. The larvæ are grayish with a black head. To our knowledge it has appeared thus far in Berrien county only, but it may be expected, in the course of a few seasons, to extend its range to the entire southern portion of the State.

REMEDIES.

While the asparagus beetle, if allowed to have its way, will put a serious impediment in the way of asparagus growing, it is easily held in check by a careful and conscientious use of the measures recommended.

Seedlings and old plants not at the time being used for the table or market should be sprayed with Paris-green. This will dispose of both the beetles and grubs on them if repeated from time to time. The fields which are being regularly cut for use should not be sprayed on any account, because of the danger to human life, but a practice should be made of always leaving some young shoots for the beetles to lay their eggs upon, and these shoots should be cut and burned before they are a week old to destroy the eggs, which otherwise would hatch at the end of eight days. If such patches be systematically left all over the field and carefully cut and burned at the proper time, early in the season, the beetles will be found to decrease in number as the season advances. As soon as the cutting season is over the whole field should be sprayed from time to time with Paris-green and all rubbish about the field should be burned late in the fall.

Air-slaked lime will kill many grubs if dusted on them, as will also Pyrethrum. Kerosene-emulsion also will kill them, but the methods first named have thus far proved the most effective.

THE PEAR SLUG.

(*Eriocampa cerasi.*)

The family of saw-flies takes its name from a saw-like appendange or ovipositor with which the female plows or gouges out a pocket or furrow in which to place the eggs. They are not true flies at all, but the adults are somewhat wasp-like in appearance. The larvæ of most saw-flies are soft and somewhat sticky "worms or slugs," and many of them are quite injurious to vegetation.

The larva of the pear-slug or cherry-slug (Fig. 25) is a shiny, dark-green

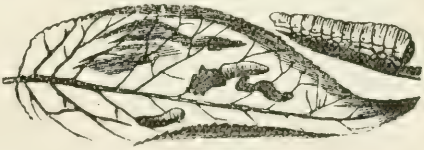

FIG. 25. Pear Slug (*Eriocampa cerasi*).

worm about half an inch long. It works on the leaves of the pear and cherry, scraping off the soft part in patches, but leaving the veins. Sometimes when very numerous, as they were during the past summer in the western part of the State, they do a great deal of damage.

REMEDIES.

The sticky, viscous nature of these worms gives us an excellent means of fighting them. Any dry powder which is caustic and which will not injure foliage, such as air-slaked or dry-slaked lime, will stick to the skin and eventually kill them. Hellebore is perhaps the best remedy of this nature; it should be diluted three times with flour, but, unfortunately, Hellebore is expensive and for this reason it is often better, if the orchards are large ones, to spray with Paris-green, using one pound of the poison to 150 or 200 gallons of water, always adding lime. (See chapter on insecticides.)

Sometimes the worms come on after cherries are pretty well grown, and in this case Paris-green or any arsenical poison should not be used, because of its poisonous properties, but a spray of kerosene-emulsion (Hubbard's formula), diluting ten times with soft water. Whale-oil soap is recommended as being very effective, using twelve pounds of the soap to fifty gallons of water.

THE WHITE-PINE SAW-FLY.

(*Lophyrus lecontei* Fitch.)

About July 13 the white pines on the campus were seen to have colonies of small, naked caterpillars scattered through their branches. None of the colonies were large and the injury to the trees was very slight. Nothing more was noticed until near the middle of September, when these little false-caterpillars again appeared. This time, however, their work was not limited to the defoliation of a few branches, but the work of destruction continued until the middle of October, and occasional specimens were to be seen even in November. The trees were sprayed where this could be done easily, but the damage was very considerable in spite of everything. Large trees lost a third of their foliage, and it seems no exaggeration to say that the worms could be measured by the bushel.

These little false-caterpillars (Fig. 26) are the larvæ of saw-flies. They are yellowish or greenish-white in color, and when full-grown measure three-quarters of an inch in length. They are provided with twenty-two legs. The head is jet black, as are also four rows of spots which run the entire length of the body. Two rows of elongated spots run down the back, while on each side is a row of broader squarish spots. There is a great

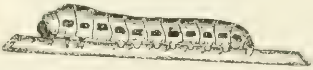

FIG 26. White-pine Saw-fly (*Lophyrus lecontei*); larva.

deal of variation both in the size and shape of these markings. In the younger stages, some of the caterpillars are marked like the adults, while others are unspotted. The worms feed in colonies or bunches, each bunch occupying part of a limb and stripping it of leaves. It is a curious fact that the worms of a single colony are usually marked very much alike, being probably the offspring of a single parent, while different colonies exhibit a good deal of variation.

After the worms attained full size they descended to the ground and spun very pretty cylindrical cocoons with rounded ends. In color these cocoons varied from white to bronzed-brown, and in size from one-quarter to three-eights of an inch in length. They are usually buried in the fallen needles or in the grass under the tree. Fortunately, the great majority of these cocoons are placed directly under the tree, although a certain proportion of the larvæ travel some distance before spinning. When placed in breeding-cages and kept in a warm room, the adult saw-flies (Fig. 27) commenced to emerge about November 8, and continued to come out for over two weeks. Under natural conditions they remain in the cocoon until spring, and then come out in great numbers.

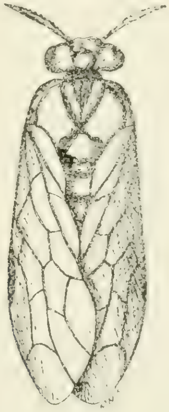

FIG. 27. White-pine Saw-fly (*Lophyrus lecontei*); adult insect. (Original.)

Some accounts of this insect describe the cocoons as attached to the leaves of the pine. Specimens of cocoons thus placed were received from Centreville, Mich., and these, as well as the accompanying larvæ, were indistinguishable from the cocoons and larvæ found here.

This saw-fly usually has been considered as one-brooded, but its behavior in this instance would seem to indicate that it is double-brooded and that the July larvæ furnished the saw-flies that laid the eggs for the more numerous fall brood.

Fortunately, these worms are usually kept in check by parasites, but when for some unknown cause the balance of life is disturbed and the parasites suddenly decrease in number, we may expect a sudden appearance of the pest and be driven to artificial means for the protection of our parks and shade trees.

REMEDIES.

The drawback in fighting these insects arises from the difficulty of applying remedies in the inaccessible places that they inhabit. In places where shade-trees are affected, it is usually possible to apply sprays. The larvæ readily succumb to a spray of Paris-green or kerosene-emulsion. While the former is cheaper, the latter is preferable where for any reason it is unsafe to apply poisons. The great height of pine-trees often makes it impossible to reach the top with a spray; in such cases hellebore should be applied. Mix one part of white hellebore with three parts of flour and tie up a pound or so in a piece of coarse cheese-cloth or in four or five thicknesses of mosquito-netting. This should be tied to a long pole and taken up into the tree on a still day. By going above the infested part and beating the pole with another stick the powder will be sifted out and will settle on the worms. It is best to do this on a quiet morning when the dew is on the trees. The hellebore will act in two ways, some will stick to the moist bodies of the worms and some will settle on the leaves and be eaten, in either case the worm will be destroyed. If a dust-gun is to be had, this may be used more quickly and effectively, but in most cases the injury is well advanced before it is noticed, and if the trees are to be protected there is no time to procure such apparatus. In November all the fallen needles and debris should be raked from beneath the affected trees for some distance around, and burned to destroy the cocoons.

FORMULAS AND DIRECTIONS FOR USE OF INSECTICIDES.

To be of much service, spraying must be thoroughly done. A conscientious and thorough spraying will wet every part of every limb, twig and leaf on both sides. To accomplish this result cheaply and surely, a spray as fine and mist-like as possible must be used. When a poor nozzle is used, one that projects a coarse spray composed of distinct drops of liquid, much is sure to fall to the ground and be lost. Good nozzles save enough insecticide to pay for themselves in a short time. When contact insecticides, such as kerosene-emulsion or whale-oil soap, are used, each insect must be fairly hit with the liquid to be killed.

Insects that chew or bite their food are usually most cheaply and effectually killed with arsenites, such as Paris-green, while those that suck their food from beneath the surface of the plant have to be killed by contact insecticides, such as kerosene-emulsion, whale-oil soap, etc. In some cases insects that chew have to be killed with contact insecticides; for instance, when they are on fruits or vegetables nearly mature or on which it would be dangerous to use Paris-green because of its poisonous properties.

The pump should be strong and well made, of sufficient capacity to throw the one or two sprays required without too great exertion. An attempt to spray a large orchard with a pump designed to use on small garden plants is discouraging, to say the least.

When large, high trees are to be sprayed, it is often found best to build an elevated stage on top of the wagon-tank or over the barrel containing the liquid. To reach the top of the tree, it is usually best to fasten the nozzle to the tip of a strong bamboo or to attach it to a length of half-inch gas-pipe and send the stream of liquid through the gas-pipe. At least fifteen feet of hose should be allowed in order to reach all parts of the tree.

Never spray a tree when in bloom, it may kill bees, both wild and hive-bees.

Stone fruits require especially careful treatment; they are easily injured by sprays not properly mixed or prepared.

INTERNAL POISONS FOR INSECTS THAT CHEW.

PARIS-GREEN.

At the head of all the stomach poisons stands Paris-green or arsenite of copper. To prepare Paris-green for spraying, slake one pound of well-burned quick-lime in hot water and stir in one pound of Paris-green. Allow this mixture to stand over night, strain, and then stir it into from 150 to 250 gallons of water. Keep the liquid well stirred while spraying. For most insects, one pound to 200 gallons of water is sufficient, and at this rate it will not injure the plant. Stone fruits, such as peach, plum and cherry, should not receive a spray much stronger than this, but apples, pears, etc., may be sprayed with a mixture considerably stronger, viz.: one pound to 150 gallons of water. Potatoes may be sprayed with one pound to 100 gallons of water. Paris-green is fairly uniform in composition if not adulterated, and is perhaps the safest and surest remedy for chewing insects as a whole.

LONDON-PURPLE.

Next to Paris-green comes London-purple, which is used in the same way, except that twice as much lime should be mixed with it. Its effect is a good deal the same, though it is far more variable in composition and more likely to burn the foliage; it should never be used without lime.

DRY METHOD.

While ordinarily it is most economical to use Paris-green in the form of a spray, in some instances, where only a few plants are to be treated or where no pump is available, it is expedient to use it as a dry powder. It should then be mixed at the rate of one pound of the poison to 100 pounds of plaster, flour, or air-slaked lime, and dusted on the plants through a sack of burlaps or some loose, coarse cloth. It is best to make the application in the morning when the dew is on the plants. Never apply dry poisons where the wind can blow the powder into pastures or places where cattle or horses are feeding.

ARSENITE OF LEAD

This poison, although not in general use throughout the country, has several advantages; it shows where it has been applied; it is light and does not require such vigorous stirring as Paris-green; it does not easily burn the foliage, and it is cheap. To prepare it, dissolve four ounces of arsenate of soda and eleven ounces of acetate of lead, each in a gallon of water. On mixing the two solutions together we shall get a milky precipitate, which should be stirred into 100 gallons of water. It is now ready for spraying. Of course, larger or smaller quantities may be made in the same proportion, and if this preparation does not seem strong enough, it may be applied much stronger with safety.

Its action is slower than that of Paris-green, but the fact that it does not readily burn foliage is an advantage when spraying various kinds of trees with one mixture.

CONTACT INSECTICIDES, FOR INSECTS WHICH SUCK THEIR FOOD.

The most effective contact insecticides are kerosene-emulsion and whale-oil soap. Kerosene-emulsion may be used against all lice (except bark-lice), bugs, etc., which do not succumb to the internal poisons. To be effective it must be very carefully made and conscientiously applied.

Place two gallons of ordinary kerosene in a warm place, either in a warm room or in the sun, and allow it to become as warm as possible without danger from fire. Boil one pound of laundry soap or whale-oil soap in a gallon of soft water until completely dissolved. If the water is the least bit hard, "break" it with washing soda. Remove the soap solution from the fire, and while still boiling hot add the kerosene and agitate for ten minutes, or until the oil is emulsified, with a spraying-pump by forcing the liquid back into the vessel from which it was pumped.

When the liquid is perfectly emulsified it will appear creamy in color and will flow evenly down the side of the vessel. Care should be taken to completely emulsify the oil, and this is accomplished much more easily when the mixture is hot. This strong emulsion may now be readily diluted with water and used, or it may be stored away for future use. When cold it becomes like sour milk in appearance, and should be dissolved in three or four times its bulk of hot water before diluting with cold water.

Small amounts of this emulsion may be made by using the ingredients in small quantities, but in the same relative proportion.

It should be diluted ten times for most insects, but many plants are able to resist a stronger mixture, which is usually more effective.

WHALE OIL SOAP.

This insecticide is rapidly coming into favor. It may be used at the rate of one pound to from four to six gallons of water for plant-lice and many other insects. For winter spraying it is used at the rate of two pounds to a gallon of water. This is the most effective remedy known against the San José scale.

Whale-oil soap should cost about four cents per pound when bought in quantity. It requires no preparation other than dissolving in water, and ordinarily is easily applied. Care should be observed to get an article that will not turn to a jelly when dissolved at this rate, for jellied soap is very difficult to spray. The above strength, two pounds to a gallon, should never be applied except in the winter when the trees are entirely dormant, for an application when the buds are swelling or when the leaves are on the tree is sure to do great injury to the tree.

PYRETHRUM.

(Buhach or Persian Insect Powder.)

Pyrethrum is a powder made by grinding the heads of a plant resembling our daisy. It is produced in great quantities in California, where it is sold under the proprietary name of "Buhach." It is also imported from Persia and known as "Persian insect-powder." Now, the insecticidal value of the Pyrethrum lies in an oil which readily passes off into the air, and to prevent the loss of this the powder should always be kept tightly sealed in metal cans. Insect-powder that has been exposed for sale in open cans in drug-store windows is next to worthless, and should on no account be purchased. This insect-powder is harmless to all animals breathing by means of lungs. It can be used either dry or in the form of an alcoholic extract. To apply it dry, dust the powder on the insects either by means of a bellows or in some other way. To apply in the form of an extract, place four ounces of the powder in a pint of alcohol, leave it for a week and filter, then dilute once with water, and apply with an atomizer.

HELLEBORE.

White hellebore is the powdered root of a plant. It kills both by contact and as an internal poison. It may be applied either dry or in the form of a liquid. When used dry it should be mixed with three or four times its weight of flour or plaster and then dusted on the insects. Applied wet, one pound should be mixed with twenty-five gallons of water and this liquid applied as a spray. A convenient form of duster is made as follows: A tin box like a pepper-box, holding a quart or less, is fastened to a stick about six feet long by means of a screw running through the bottom of the box into the stick. The cover of this box should be finely perforated to allow the poison to come out very slowly when shaken. This box can then be shaken over the infested plants and the insects peppered or dusted with the poison.

Hellebore is especially useful against all moist-bodied insects, such as currant-worms, pear and cherry-slugs, etc., for the poison sticks to their bodies.

THE GASOLINE BLAST.

During the season of 1897, an apparatus was devised for burning scale insects on the tree. An ordinary gasoline blast-lamp or soldering torch such as is used by plumbers was fitted with five parallel burners so arranged that a broad sheet of flame about ten inches wide could be directed on the tree. A torch of this sort was made for the writer in the fall of 1897 and during the winter several tests were made.

When the flame is passed over the body of a scale-coated tree, the scales instantly change color and many drop off. If rubbed the scale is seen to be loosened and on examination with a lens shows minute lines resembling cracks running in all directions over the surface. Now the trunk and larger limbs of trees are often covered several layers deep with the scales and in such cases this method of treatment seems useful. It destroys most of the insects and so loosens the mass that it is possible afterwards to penetrate to the bottom with a spray. The heat produced by this lamp is very intense and great care must be observed not to allow the flame to remain at any one point long enough to injure the tree. In the experiments tried, the best results were obtained when the flame was steadily moved so that it covered a space of a yard in length in from five to ten seconds. The trials were made on peach and pear trees badly affected with the San José scale, and during the winter months while the trees were dormant. The results seemed to show that the blast will kill the scale-insects with little or no injury to the tree; the trees were scorched in places where the flame had moved too slowly and the care necessary to avoid the scorching appears to be the most serious drawback to the use of the blast-lamp. In careless hands much injury may be done in a very short time while the skilful handling necessary for success would be rather expensive under ordinary circumstances. Good judgment must be exercised always and the rapidity and effectiveness of the work will be much modified by the temperature of the air, the direction and force of the wind, the age of the tree and the thickness of the encrusting scales. Under favorable conditions we believe the blast-lamp can be used to good purpose and economically in destroying scale-insects, but we are not prepared to recommend it for general use as superior or even equal to treatment by spraying.

FARMERS' INSTITUTES.

REPORT OF INSTITUTE WORK FOR SEASON OF 1897–8.

BY KENYON L. BUTTERFIELD, SUPERINTENDENT OF INSTITUTES.

The third season under the present Institute law, taken as a whole, was the most successful of all. We were able to give to the various counties, to a large decree, the speakers and topics they wished, and, so far as our programs were concerned, we believe that we largely met the wishes of the people. On the other hand, local work was better done than ever before. In most counties the meetings had been well worked up, the advertising was good, and the attendance larger than ever before. In certain counties small attendance at the county meetings can be accounted for by severe storms prevailing at the time of those meetings.

The appropriation for Institutes was increased by the legislature of 1897 from $5,000 per year to $5,500 per year. The bill, as introduced, called for $6,000 per year. It was thought that with another $1,000 we could hold at least 100 One-day meetings in addition to the regular County meetings. The legislature saw fit to give but $500 for this purpose, and with it we succeeded in holding 71 One-day meetings.

ACKNOWLEDGMENTS.

We should be guilty of serious ingratitude if we did not freely and emphatically acknowledge the splendid work of the officers of County Institute Societies, and especially the large body of efficient Secretaries and Presidents, some of whom put in days and weeks of time to make the Institute work in their county a success. The fact that from whatever standpoint we view the subject the past season of Institute work is by far the most successful ever held in Michigan, shows the faithfulness and zeal, the intelligence and ability, of these officers.

In connection with this we wish to affirm that it is no more than just that all officers of Institute Societies should receive their entire expenses when doing Institute work. There is scarcely a Society in the State which, by proper efforts, cannot raise enough funds from membership fees not only to pay the necessary expense of the Institute themselves, but to make sure that no officer is out a single cent for expenses incurred in doing Institute work. We know from private letters that this is not always done. In some counties where the agricultural interests and the interests of Institute work are sufficient to maintain a vigorous and flourishing County Society, the leading officers have been compelled not only to spend their time but also a considerable amount of money in the prosecution of their Institute duties. This should not be tolerated by any Institute Society.

We also desire to express our obligations to our State workers. Some one has said that the secret of Institute work is in sending out the right kind of men as speakers; that all the machinery, of Institute work is useless unless the men who do the work are the kind of men they should be. We believe that the success of our work the past year can be attributed in great degree to the zeal and devotion of our State speakers. True, it may be said that our paid workers receive good compensation and should have rendered good services. But no one who has watched the work closely can fail to feel that the earnestness, character, enthusiasm, and even sacrifice, of our Institute workers have contributed largely to the successful work, and deserve especial recognition beyond that of any remuneration the workers may receive.

We wish especially to thank the members of the Faculty of the Agricultural College and of the University of Michigan, as well as other members of various State boards and institutions, for their work, which was rendered gratuitously, but which was performed thoroughly and earnestly.

As in years gone by, the newspapers of the State have been firm allies of the Institutes and one of the chief factors in making them a success. Most of our Secretaries admit that newspaper notices are the best form for advertising an Institute. We wish, therefore, to publicly acknowledge our debt to the newspaper fraternity for their interest and aid.

We wish also to acknowledge the very material help which the railroads of Michigan have granted us in the form of half fares for our Institute speakers while on Institute work. We have also usually been favored with lower rates at hotels. A glance at our financial statement will show that the largest item of expenditure is that for travel, which includes railroad and hotel bills. Thus it will be seen at once that half fare on the railroads and reduced rates at hotels mean a great saving to the Institute fund.

THE LONG INSTITUTES.

In continuance of former plans, we offered a Long Fruit Institute and also a Long Dairy Institute during the past season. The Long Fruit Institute, of four days, was placed at Grand Rapids. The attendance here was good. The interest was very good indeed, delegates coming from many of the adjoining counties, and even from distant counties, to attend the meeting. The following program indicates the work done:

PROGRAM OF LONG FRUIT INSTITUTE

AT GRAND RAPIDS, KENT COUNTY, FEBRUARY 15, 16, 17, 18, 1898.

PROF. L. R. TAFT, CONDUCTOR.

TUESDAY, FEBRUARY 15.

FORENOON.

10:00—"Diseases of pome fruits," Prof. L. R. Taft.
10:50—"Peaches and plums: starting the orchard—location, soil, planting," Roland Morrill.
11:45—Adjourn for dinner.

AFTERNOON.

1:15—Question box.
1:45—"The relation of bees to the fertilization of flowers," Prof. Walter B. Barrows.
2:35—"Strawberries," Prof. L. R. Taft.
3:15—"Peaches and plums: cultivation and care," Roland Morrill.

WEDNESDAY, FEBRUARY 16.

FORENOON.

10:00—"Diseases of stone fruits," Prof. L. R. Taft.
10:50—"Peaches and plums: fertilization and cover crops," Roland Morrill.
11:45—Adjourn for dinner.

AFTERNOON.

1:15—Question box.
1:45—"A few insect enemies of orchard fruits," Prof. Walter B. Barrows.
2:25—"Raspberries and blackberries," Prof. L. R. Taft.
3:15—"Peaches and plums: pruning and thinning," Roland Morrill.

THURSDAY, FEBRUARY 17.

FORENOON.

10:00—"Diseases of small fruits," Prof. L. R. Taft.
10:50—"Peaches and plums: getting the product ready for market," Roland Morrill.
11:45—Adjourn for dinner.

AFTERNOON.

1:15—Question box.
1:45—"Some insects attacking small fruits," Prof. Walter B. Barrows.
2:25—"Currants and gooseberries," Prof. L. R. Taft.
3:15—"Peaches and plums: marketing—methods and results," Roland Morrill.

FRIDAY, FEBRUARY 18.

FORENOON.

10:00—"The treatment of plant diseases," Prof. L. R. Taft.
10:50—"Peaches and plums: varieties," Roland Morrill.
11:45—Adjourn for dinner.

AFTERNOON.

1:15—Business meeting, etc.
1:45—"The natural enemies of insects," Prof. Walter B. Barrows.
2:25—"Grapes," Prof. L. R. Taft.
3:15—"The horticultural situation," Roland Morrill.
4:00—Question box.

The Long Dairy Institute was held at Hudson. Bad roads lessened the attendance, but we learned afterwards, what we did not know before, that the dairy interest in the vicinity of Hudson was not the leading interest. As a consequence there was not the intense enthusiasm evoked by the dairy meeting that there was by the Fruit Institute.

The following is the program:

PROGRAM OF LONG DAIRY INSTITUTE

AT HUDSON, LENAWEE COUNTY, FEBRUARY 15, 16, 17, 1898.

PROF. CLINTON D. SMITH, CONDUCTOR.

TUESDAY, FEBRUARY 15.

FORENOON.

10:00—"The dairy the source of wealth in Lenawee county," Hon. Geo. B. Horton, Fruit Ridge.

11:00—"The Babcock test and the eye in selecting dairy cows," Mr. Gordon H. True, Agricultural College.

AFTERNOON.

1:30—"The feeding and care of the dairy herd," C. P. Goodrich, Ft. Atkinson, Wis.

3:00—"Stall fixtures and stall feeds," Prof. Clinton D. Smith, Agricultural College.

EVENING.

8:00—"Dairy bacteriology" (illustrated with stereopticon), Mr. C. E. Marshall, Agricultural College.

WEDNESDAY, FEBRUARY 16.

FORENOON.

10:00—"Silage and its place in the ration," Jas. Helme, Adrian.

11:00—"The relation of the Agricultural College to dairy prosperity," Mr. Gordon H. True.

AFTERNOON.

1:30—"Making butter on the farm," C. P. Goodrich.
Discussion led by Gordon H. True.

3:00—"Home dairy or factory, which?" Prof. Clinton D. Smith.

EVENING.

7:00—"The fight against oleomargarine," Dairy and Food Commissioner E. O. Grosvenor.

8:00—"Development of the dairy cow" (illustrated by stereoptican views), Prof. Clinton D. Smith.

THURSDAY, FEBRUARY 17.

FORENOON.

9:30—"Why, what, and how of the cheese factory," N. G. Strong, Hudson.

11:00—"Marketing dairy products," C. P. Goodrich.

AFTERNOON.

1:30—"The farmer's side of factory butter making," Prof. Clinton D. Smith.

2:30—A general discussion on dairy subjects, including feeding and care of the cows, handling the milk, and making butter and cheese.

Papers to be 30 minutes long, and followed by discussion in every case.

FARMERS' DAY AT BAY VIEW.

By invitation of Mr. John M. Hall, superintendent of the Bay View Assembly, we co-operated with him in a Farmers' Day at Bay View. This meeting was held August 18. Institute societies in adjoining counties advertised the Institute, and although the day proved to be very rainy, there was an attendance of probably 75 or 100 farmers, besides a goodly attendance of Bay View summer residents.

The Program was as follows:

"Practical Education," Pres. J. L. Snyder, Agricultural College.

"Home Life on the Farm," Mrs. Mary A. Mayo, Battle Creek.

"The Farmer's Isolation; Its Import and its Remedies," Hon. John M. Stahl, Illinois.

The farmers present expressed themselves as thoroughly pleased with the meeting, and we believe also that those not farmers were impressed with the importance of the farming problem, and were brought into sympathy with the work being done by and for farmers.

THE STATE ROUND-UP.

The State Round-up was held at the Michigan Agricultural College, February 22-25. It will be remembered that our first State Round-up was held in Grand Rapids, and that the attendance from outside Kent county was quite large. The second Round-up was held at St. Louis, Gratiot county, and while the total attendance at the meeting was very large it was almost exclusively made up of people living in Gratiot county. We were led by our experience to feel that the State Round-up should be just what the term implies, not simply an enormous county meeting, good as such a meeting is. We therefore proposed to the Agricultural College authorities that they entertain the Round-up this year. They promised to do so, and performed their part at the sacrifice of much time and considerable money.

Every effort was bent upon making the Round-up a State affair. The program was arranged with reference to what were thought to be the great needs of the day in Michigan farming. Everything was subordinated to the value and appropriateness of the program for the special needs of the time. In advertising every effort was made to secure a large attendance from outside the immediate vicinity of the College, and to secure delegates from all the County Institute Societies and the various Granges and Farmers' Clubs of the State.

The results of the Round-up were beyond our anticipations, with the exception that we were disappointed somewhat in the attendance of farmers living within driving distance of the College. Forty seven counties were represented, with a total attendance of 212 and quite a number were in attendance who did not register. This attendance does not include the attendance from Lansing, the College, nor of those who live within driving distance of the College. That our figures are approximately correct is shown by the fact that the railroad authorities received 210 railroad certificates for approval.

We believe that our Round-up was, in all respects, a success, and we are encouraged to plan for another year a meeting on similar lines. We believe that all who attended were thoroughly pleased not only with the program but also with the College, and besides that all went home full of genuine enthusiasm for Institute work. It was an object lesson in the power of Farmers' Institutes and of the work they are doing. We can state, without flattery, and we believe the statement is within the bounds of truth, that never before in the history of Michigan has there been so large a body of representative farmers sitting for the same length of time and discussing such a variety of practical topics bearing on the industry of agriculture.

PROGRAM OF THE THIRD ANNUAL MICHIGAN ROUNDUP FARMERS' INSTITUTE,

HELD AT THE AGRICULTURAL COLLEGE FEBRUARY 22, 23, 24 AND 25, 1898, UNDER THE JOINT AUSPICES OF THE MICHIGAN AGRICULTURAL COLLEGE AND MICHIGAN FARMERS' INSTITUTES

TUESDAY, FEBRUARY, 22.

Tuesday afternoon and evening were devoted to conferences of our State Farmers' Institute Lecturers. The public Institute proper began Wednesday forenoon.

WEDNESDAY, FEBRUARY 23.

FORENOON.

IN THE CHAPEL.

8:30 to 9:30—Conference of officers of County Farmers' Institute societies.

IN THE ARMORY.

9:45—"A Word of Welcome," President J. L. Snyder, Agricultural College.
10:00—"The Ideal Mutton Sheep," Hon. George McKerrow, Superintendent Farmers' Institutes of Wisconsin.
10:20—Discussion, led by Prof H. W. Mumford, Agricultural College.
10:40—Ten-minute talks on "The Selection of Ideal Animals:"
  "The Beef Steer," Jason Woodman, Van Buren county.
  "The Profitable Hog," I. N. Cowdrey, Gratiot county.
  "The Dairy Cow," A. M. Welch, Ionia county.
11:10—Discussion on the last three topics.
11:30—"To What Extent can the Grain and Stock Farmers of Michigan Improve the Market for their Products?" Robert Gibbons, Editor "Michigan Farmer."
12:00—Discussion.
12:30—Adjourn for dinner.

AFTERNOON.

IN THE ARMORY.

1:45—Question box.
  General topic for the afternoon, "Soil Fertility."
2:00—"The Stock Feeder's Side of the Fertility Question," Hon. Wm. Ball, Livingston county.
2:20—Discussion.

2:45—"Commercial Fertilizers," L. J. Post, Kent county.
3:00—Discussion.
3:20—"How I Preserve the Fertility of My Farm," T. B. Terry, Hudson, O.
4:00—General discussion on the Preservation of Soil Fertility.

EVENING.

IN THE ARMORY.

7:00—Concert by the M. A. C. band.
7:30—"The Oleomargarine Fight," Hon. E. O. Grosvenor, State Dairy and Food Commissioner.
"Traveling Libraries," Mrs. Mary C. Spencer, State Librarian.
"The Advantages and Possibilities of Union of Action Among Farmers," Hon J. H. Brigham, Assistant Secretary of Agriculture.
Discussion after each address, if desired.

THURSDAY, FEBRUARY 24.

FORENOON.

IN THE CHAPEL.

8:30 to 9:30—Conference of officers of County Farmers' Institute societies.

IN THE ARMORY.

9:30—Question box.
General topic for the forenoon, "Markets and Marketing."
10:00—"The Marketing of Fruit," with 10 minute talks on each of the following topics:
1. "Creating a Market," J. N. Stearns, Kalamazoo county.
2. "Preparing the Product for Market," A. P. Gray, Grand Traverse county.
3. "The Home Market," R. M. Kellogg, St. Joseph county.
4. "Transportation and Co-operation," Hon. R. D. Graham, Kent county.
5. "The Commission Man," Roland Morrill, Berrien county.

10:50—General discussion on the above topics.
11:30—"Markets and the Department of Agriculture," Hon. J. H. Brigham. Followed by discussion.
12:30—Adjourn for dinner.

AFTERNOON.

IN THE ARMORY.

1:45—Question box.
2:00—"Up-to-date Stock Feeding and Management," Colon C. Lillie, Ottawa county.
2:30—Discussion.
3:00—"Sugar Beets for Michigan," Dr. R. C. Kedzie, Agricultural College.
3:30—Discussion.
4:00—"The Practical Culture of Sugar Beets," Prof. Clinton D. Smith, Agricultural College.
4:30—Discussion.

EVENING.

IN THE ARMORY.

Music for the evening furnished by the Musical Department of the College.

7:00—"How to Keep Boys and Girls on the Farm," Mrs. Mary A. Mayo, Battle Creek.
"The Bequests We Make Our Children," Dr. Mary Wood-Allen, Ann Arbor.*
"The Wife's Share," T. B. Terry.
Discussion to follow each address, if desired.

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*Dr. Wood-Allen, on account of illness, was unable to attend the institute.

FRIDAY, FEBRUARY 25.

FORENOON.

IN THE CHAPEL.

8:30 to 9:30—Conference of officers of County Farmers' Institute societies.

IN THE ARMORY.

9:30—Question box.
10:00—"The Creamery vs. The Home Dairy."
"The Creamery," E. A. Croman, Jackson county.
"The Home Dairy," J. H. Brown, Kalamazoo county.
10:40—Discussion, led by G. H. True, Agricultural College.
11:15—"The Horticultural Situation," Roland Morrill.
Discussion, led by Prof. L. R. Taft, Agricultural College.
12:30—Adjourn for dinner.

AFTERNOON.

IN THE ARMORY.

1:45—"Possibilities of Northern Michigan," A. E. Palmer, Kalkaska county. Discussion by northern Michigan delegates, etc.
2:45—"What the State Might Do in the Way of Inducing the Settlement of Northern Michigan," Hon. Sybrant Wesselius, Commissioner of Railroads.
3:15—"Forestry in Relation to Northern Michigan," Hon. C. W. Garfield, of the Board of Agriculture.
3:45—"Potato Growing," T. B. Terry. Followed by discussion, and final question box, if desired.

EVENING.

IN THE ARMORY.

7:00 (sharp)—Informal reception, given by the faculty of the College to all visitors to the Institute.
8:00—"Higher Education and the People," Pres. H. B. Hutchins, Ann Arbor.
"Education for the Industrial Classes," Pres. J. L. Snyder, Agricultural College.
"The Farmers and their Public Duties," Gov. H. S. Pingree.
Music for the evening furnished by the Hesperian Society Orchestra.

WOMEN'S SECTION.

HELD IN THE CHAPEL ON THE AFTERNOONS OF WEDNESDAY, THURSDAY AND FRIDAY, FEBRURARY 23, 24 AND 25.

CHAIRMAN AND CONDUCTOR, MRS. MARY A. MAYO, BATTLE CREEK.

WEDNESDAY AFTERNOON, FEBRUARY 23.

1:45—"Greeting," Mrs. Mary A. Mayo.
2:00—"The Relation of the Farmer's Wife to Society," Mrs. Ella E. Rockwood, Flint.
3:00—"Industrial Education," Mrs. Irma T. Jones, Lansing.
4:00—Question box.

THURSDAY AFTERNOON, FEBRUARY 24.

2:00—"The Relation of the Mother to the Country Schools," Mrs. Mattie A. Kennedy, Slocums.
3:00—"Consecrated Parentage," Mrs. Belle M. Perry, Charlotte.
4:00—Question box.

FRIDAY AFTERNOON, FEBRUARY 25.

2:00—"Literary Clubs and the Farmer's Wife," Mrs. Ella E. Rockwood.
3:00—"Ideal Womanhood," Dr. Mary Wood-Allen, Ann Arbor.
4:15—Question box.
Discussion after each address.
Music furnished by the Department of Music of the College.

RESOLUTIONS.

Among the resolutions passed by the Round-up Institute were the following:

GRAIN INSPECTION.

A resolution was passed by the Institute authorizing a committee of three to draw up resolutions relative to the subject of grain inspection, to be acted upon by the Institute. The committee appointed submitted the following resolutions, which were unanimously adopted:

Whereas, It is the opinion of the farmers in attendance at this Institute, comprising representatives from nearly every county in the State, that the present system of grading its grain and seed crops is working injuriously to the interests of producers, and has greatly damaged the reputation of Michigan's grain crops; it is, therefore, hereby

Resolved, That it would be of great financial benefit to the grain growers of the State, add much to the reputation of Michigan's grain crops, and aid in improving their quality, to have a system of inspection by State officials which will insure to the grain grower proper remuneration for the quality of grain he produces;

Resolved, That we earnestly protest against the present system of mixing and degrading our grain so as to rob the producer of his due reward, and advertise him as a grower of grain of such poor quality that it brings only the lowest prices in the markets of the world, and ask that we be relieved from a system which compels us to pay for the cost of defrauding ourselves;

Resolved further, That in behalf of the farming interests of the State, we respectfully urge upon the Legislature prompt an deffective legislation to remedy the grievance complained of;

Resolved, That a committee be appointed by this Institute to present these resolutions to the Legislature of the State at its next meeting, and urge that the necessary legislation to this end be enacted at as early a date as possible.

ROBT. GIBBONS,
E. C. DAVIDSON,
JAS. E. CODY,
Committee.

In accordance with this resolution, the Superintendent of Institutes appointed the following committee to bring this subject to the attention of the people and the legislature:

Robt. Gibbons, Detroit, chairman.
Hon. John K. Campbell, Ypsilanti.
Hon. John C. Sharp, Jackson.

DEVELOPMENT OF NORTHERN MICHIGAN.

On Friday the Institute adopted the following:

Resolved, That the chairman be authorized to appoint a committee of five to advise with the proper officers of the State as to measures that may be adopted to develop the unsettled farming lands of the State, and to co-operate with said officers in securing the adoption, by the State, of such measures.

In accordance with this resolution, the Superintendent of Institutes appointed the following committee to bring this matter to the attention of the people of the State and to take such other steps as shall, in their judgment, seem wise in order that the spirit of the resolution may be carried out:

A. E. Palmer, Kalkaska, Kalkaska county, chairman.
E. C. Davidson, Rudyard, Chippewa county.
Hon. W. J. Oberdorffer, Stephenson, Menominee county.
Stewart Gordon, Luzerne, Oscoda county.
Fremont E. Skeels, Assistant Secretary, Agricultural College.

CONFERENCES.

Tuesday, February 22, was devoted to a conference of Institute workers. The following program indicates the scope of the conference. Discussion was free, and there is no question about the good results of such a meeting. The following is the program:

CONFERENCE OF INSTITUTE WORKERS.

HON. C. J. MONROE, CHAIRMAN.

Tuesday Afternoon, February 22, 1898, 1:30.

1. "How to get the most out of an Institute," Geo. McKerrow, Superintendent of Institutes, Wisconsin.
2. "The position and work of the Institute Conductor in Michigan," C. B. Charles.
3. "How can local work be improved?" A. E. Palmer.
4. "One-day Institutes," Wm. Ball.

Evening, 7:00.

1. "Gleanings from the Institute field," T. B. Terry, Ohio.
2. "The sunshine and shadows of Institute work," Mrs. Mattie A. Kennedy.
3. Roll call of workers for this present season, with one minute suggestions from each, for improving the work in Michigan.

Evening, 8:30.

Social hour. Lunch served by the Domestic Economy Department of the College.

CONFERENCES OF INSTITUTE OFFICERS.

Each forenoon of the Institute proper, there was arranged a conference of officers of Institute societies. The meetings were delayed in starting by the abominable street-car service, but nevertheless we had good conferences. A goodly number of officers were present, including some of the most progressive in the State. The subjects discussed, as shown in the program given below, were those which concerned the detail work of managing Institutes. They are subjects that are not always of interest to the outside public, but they are of utmost importance to those who are trying to make Institutes a success. The best illustration of the strength of Institute work that we have ever had exhibited was shown in the animated discussions on these various topics. We did not have half time enough. Two or three, and sometimes half a dozen were clamoring for recognition at the same time. Almost without exception the remarks were crisp and to the point. There can be but one opinion as to the value of these conferences of Institute officers, and we only hope that another year the attendance of officers at the Round-up may be double what it was this year. Sixty-eight were present this year.

The following topics were discussed at greater or less length at some time during these conferences:

1. "The making of the program."
2. "Effective advertising."
3. "Members of Institute Societies, and how to get them."
4. "The value and place of One-day Institutes, and how best to arrange the details."
5. "How to reach the young people."
6. "Summer meetings of Institute Societies,—are they desirable and practicable?"
7. "The functions of vice-presidents."
8. "The Women's Section."
9. "The relation of the local Granges and Clubs to the Institute work of the county."

COUNTY FARMERS' INSTITUTES, 1897-8,

WITH DATES AND ATTENDANCE.

[Attendance reported by conductors. Includes women's sections.]

County.	Place.	Date.	Attendance.	
			Total.	Average per session.
Alcona	Harrisville	Jan. 12-13, 1898	741	123
Allegan	Otsego	Jan. 21-22, 1998	2,023	404
Alpena	Alpena	Jan. 11-12, 1898	297	49
Antrim	Central Lake	Dec. 21-22, 1897	1,148	191
Arenac	Omer	Jan. 14-15, 1898	817	136
Barry	Delton	Jan. 28-29, 1898	910	182
Bay	Essexville	Jan. 17-18, 1898	913	152
Benzie	Frankfort	Dec. 15-16, 1897	515	86
Berrien	Berrien Springs	Feb. 9-10, 1898	3,185	531
Branch	Coldwater	Feb. 11-12, 1898	2,371	474
Calhoun	Burlington	Feb. 18-19, 1898	987	197
Cass	Dowagiac	Feb. 8-9, 1898	1,386	231
Charlevoix	Charlevoix	Dec. 20-21, 1897	649	108
Cheboygan	Cheboygan	Dec. 15-16, 1897	913	152
Chippewa	Pickford	Dec. 17-18, 1897	387	77
Clinton	Elsie	Feb. 9-10, 1898	1,473	245
Crawford	Grayling	Dec. 8-9, 1897	495	83
Eaton	Charlotte	Jan. 27-28, 1898	2,182	364
Emmet	Petoskey	Dec. 17-18, 1897	627	125
Genesee	Davison	Feb. 4-5, 1898	3,262	544
Gladwin	Gladwin	Dec. 2-3, 1897	637	106
Grand Traverse	Traverse City	Dec. 16-17, 1897	1,439	240
Gratiot	Ithaca	Feb. 10-11, 1898	1,925	385
Hillsdale	Reading	Feb. 16-17, 1898	2,105	351
Houghton	Lake Linden	Dec 22, 1897	57	28
Huron	Bad Axe	Jan. 18-19, 1898	2,319	386
Ingham	Mason	Jan. 26-27, 1898	1,025	171
Ionia	Ionia	Jan. 25-26, 1898	2,884	481
Iosco	Tawas City	Jan. 13-14, 1898	706	118
Iron	Iron River	Oct. 11-12, 1897	319	80
Isabella	Mt. Pleasant	Feb. 11-12, 1898	1,363	273
Jackson	Hanover	Feb. 17-18, 1898	2,319	386
Kalkaska	South Boardman	Dec. 15-16, 1897	654	109
Kent	Grand Rapids	Feb. 15-18, 1898	1,785	162
Lake	Luther	Dec. 17-18, 1897	315	79

COUNTY FARMERS' INSTITUTES, 1897-8.—CONCLUDED.

County.	Place.	Date.	Attendance.	
			Total.	Average per session.
Lapeer	North Branch	Feb. 2-3, 1898	860	172
Lenawee	Hudson	Feb. 15-17, 1898	873	109
Livingston	Howell	Feb. 3-4, 1898	1,936	323
Macomb	Romeo	Jan. 21-22, 1898	2,324	387
Manistee	Onekama	Dec. 14-15, 1897	1,100	220
Marquette	Chocolay	Dec. 20-21, 1897	326	82
Mason	Ludington	Dec. 13-14, 1897	569	95
Mecosta	Big Rapids	Dec. 21-22, 1897	442	88
Menominee	Stephenson	Oct. 5-6, 1897	1,208	201
Midland	Midland	Dec. 1-2, 1897	379	78
Missaukee	Lake City	Dec. 13-14, 1897	255	64
Monroe	Dundee	Feb. 1-2, 1898	2,510	418
Montcalm	Sheridan	Jan. 24-25, 1898	992	198
Montmorency	Big Rock	Dec. 9, 1897	100	33
Muskegon	Montague	Jan. 19-20, 1898	1,692	282
Newaygo	Grant	Dec. 22-23, 1897	770	154
Oakland	Oxford	Feb. 1-2, 1898	1,323	220
Oceana	Hart	Jan. 18-19, 1898	1,875	312
Ogemaw	West Branch	Dec. 3-4, 1897	549	110
Ontonagon	Rockland	Oct. 8, 1897	294	98
Osceola	LeRoy	Dec. 16-17, 1897	960	160
Oscoda	Mio	Dec. 6-7, 1897	366	61
Otsego	Vanderbilt	Dec. 14-15, 1897	685	114
Ottawa	Holland	Jan. 20-21, 1898	1,350	225
Presque Isle	Onaway	Dec. 17, 1897	20	20
Saginaw	Freeland	Feb. 4-5, 1898	1,915	383
Sanilac	Carsonville	Jan. 19-20, 1898	1,004	167
Shiawassee	Owosso	Feb. 8-9, 1898	2,720	453
St. Clair	Smiths Creek	Jan. 20-21, 1898	1,706	284
St. Joseph	Sturgis	Feb. 10-11, 1898	2,130	355
Tuscola	Mayville	Feb. 3-4, 1898	386	97
Van Buren	Hartford	Feb. 11, 1898	328	109
Washtenaw	Manchester	Feb. 15-16, 1898	1,201	200
Wayne	Wyandotte	Feb. 2-3, 1898	1,544	257
Wexford	Manton	Dec. 14-15, 1897	1,108	185
State Round-up	Agricultural College	Feb. 23-25, 1898	4,200	467

ONE–DAY FARMERS' INSTITUTES, 1897–8.

COUNTY ONE–DAY INSTITUTES.

There were held four One-day Institutes in as many counties not having any Institute Society regularly organized under the State law. The purpose was to get a foothold in such counties, hoping that the interest thus aroused may in time lead to the organization of a society and the consequent permanence of Institute work in the county. In each case one State speaker was assigned.

ONE-DAY SUMMER INSTITUTES.

We tried, during the summer of 1897, the plan of holding a few One-day Summer Institutes. The following were held:

County.	Place.	Date.	Attendance.	
			Total.	Av.
Lake	Luther	June 16	245	82
Lenawee	Hudson	“ 23	210	105
Lenawee	Adrian	“ 24	85	43
Grand Traverse	Traverse City	July 6	75	38
Manistee	Chief	“ 7	115	58
Benzie	Frankfort	“ 8	40	20
Lenawee	Hudson	Aug. 3	155	78
Lenawee	Adrian	“ 4	185	93
Monroe	Petersburg	“ 5	375	188
Total			1,485	79

WINTER ONE-DAY INSTITUTES.

As mentioned in the introduction to this report, an increase of appropriation of $1,000 was asked of the legislature of 1897, with the idea of thus being enabled to hold 100 One-day Institutes. Only $500 was granted by the legislature, but the Board finally decided to endeavor to hold as many One-day Institutes as possible, hoping, by strictest economy, that the appropriation would be sufficient. It was finally decided to hold approximately 75 One-day Institutes each of the two years, assigning them to the different counties on the basis of the number of farms in the county, but allowing no county more than five. In the division, 79 of these One-day meetings were assigned for the season of 1897-8. In a few cases counties did not hold their full assignment. The following table shows the assignments for the past season, and also the number actually held:

County.	Assigned.	Held.
Berrien	5	5
Calhoun	5	5
Eaton	5	5
Genesee	5	1
Gratiot	5	5
Hillsdale	5	4
Huron	5	5
Isabella	3	3
Jackson	4	4
Livingston	3	3
Mecosta	1	1
Montcalm	5	5
Newaygo	2	2
Oakland	5	5
Ottawa	4	4
Shiawassee	4	3
St. Clair	5	5
St. Joseph	3	2
Washtenaw	5	4
	79	71

We agreed to send one State speaker to each One-day Institute, requiring the meetings in each county to be held in a series, on consecutive days; also requiring that our speaker be entertained while in the county and transported from meeting to meeting. County Institute societies were requested to appoint a local manager for each One-day Institute, who should bear much the same relation to the County Secretary as that officer does to the State Board. In arranging meetings, the Superintendent corresponded both with the Secretary and President of the County Institute Society, and directly with the local manager, and the Secretary was also requested to correspond freely with the local managers.

RESULTS.

It will be seen by the table that 71 of these One-day winter meetings were held in 19 counties. We went into the work with full faith that this form of Institute would be a great success, basing our hopes upon the experiments of the previous season in Ionia and Sanilac counties. (See p. xviii, Institute Bulletin for 1896-7). Our plans were somewhat experimental, as we had little experience to go by so far as the organization for this particular form of Institute was concerned. Most of the Secretaries of counties to which the One-day meetings had been assigned took hold of the matter with enthusiasm and did an enormous amount of work to make the plan a success. Great credit is also due many of the local managers for similar hard work. In a few cases, however, we must say that, either through negligence or through misunderstanding of the plans, the attendance and results were by no means what they should have been. That this criticism is just, is shown by the results in those counties where the work was properly done. In such counties the results were beyond our expectations. The meetings were in some cases as large as the average county meeting, even in southern Michigan, and the enthusiasm and interest seemed to be fully as great.

The total attendance at these 71 meetings, found by adding together the attendance at every session, was 31,559, and the sum of the highest attendance at each meeting was 16,393. The totals for the State, including both County and One-day meetings, are as follows: Total attendance, 118,692; total highest, 40,998. Thus, if we estimate the attendance on the basis of total attendance, it will be seen that the attendance at the One-day Institutes was about *one-fourth* of the total attendance at Institutes in the State. If we take as a basis the highest attendance at any one session, we find that the attendance at One-day meetings was over *two-fifths* of the total for the State. If we wish to know the actual number of people reached, the proportion reached by the One-day Institutes probably lies between one-fourth and one-third of all those reached in the State by all forms of Institute work conducted by the State.

THE COST.

When it is remembered that this result has been achieved at an added expense of not over $500 of the Institute appropriation, and at an expense of only $184 to the counties holding the One-day Institutes, the results are even more satisfactory. In fact, from the statistics sent in by Secretaries it can be shown that *the amount of membership fees received from members secured at these One-day Institutes has more than paid for the total cost of the One-day Institutes to the County Institute Societies.* The total number of members secured was 1,483; in most of the counties the fee was 25 cents. It will be seen at a glance that the receipts from this source must have been over $300, or nearly double the amount which the One-day meetings cost the Institute Societies.

THE PLACE OF ONE-DAY INSTITUTES.

There is no question but these One-day meetings compel a great amount of hard work. The fact that they are sometimes scattered, held in communities where the plan as a whole is new, compels the County Secretary to do a vast amount of correspondence and personal travel. It is also very severe on the State speaker—speaking twice a day and driving, at night or early in the morning, from 8 to 20 miles to reach the next appointment, sometimes through mud, sometimes over rough roads, sometimes facing a blizzard. All this makes it the hardest kind of work.

But in spite of all these drawbacks we are convinced that the One-day Institute plan meets a great need and has come to stay. We only hope that there may be granted sufficient funds so that there can be held each winter from 150 to 200 of these One-day meetings in the various counties of the State, in addition to the regular county meetings. A few of our workers have become so enthusiastic in regard to the One-day meetings that they advocate them in lieu of all other work; but we do not share this opinion. We have yet to be convinced that the regular County Institute can be dispensed with. In fact, we make no pretense that the One-day meetings take the place of the county meeting—they simply supplement it, carrying the work to localities where the county meeting frequently could not go. The County Institute affords far greater variety of topics, and can be made in every respect a more advanced and perfect Institute.

To our mind, the ideal system is the holding of a two or three-day County Institute in each county, supplemented, in the more populous counties, with One-day meetings. We would strongly advocate the continuance of the plan of passing the County Round-up from place to place, and the holding of One-day Institutes in the country, or in the smaller villages, at places which have not accommodations for the regular County Round-up. We would advise the placing of the One-day Institutes in such a way that they will stand on their own feet; in other words, they should not be placed *simply* to encourage attendance at the County Round-up, although this, no doubt, will be one result.

LIST OF WINTER ONE-DAY INSTITUTES FOR 1897-8.

[Attendance reported by State speaker.]

County.	Places.	Dates,	Attendance.	
			Total.	Average per session.
Berrien	Three Oaks	Monday, Dec. 6	380	126
	Baroda	Tuesday, Dec. 7	525	175
	Benton Harbor	Wednesday, Dec. 8	325	162
	Coloma	Thursday, Dec. 9	150	75
	Bainbridge	Friday, Dec. 10	650	216
For county			2,030	156
Calhoun	Homer	Monday, Jan. 24	302	101
	Eckford	Tuesday, Jan. 25	258	129
	Battle Creek	Wednesday, Jan. 26	902	201
	Battle Creek	Thursday, Jan. 27	795	397
	West Leroy	Friday, Jan. 28	245	122
For county			2,502	227
Eaton	Sunfield	Tuesday, Jan. 4	63	63
	Grand Ledge	Wednesday, Jan. 5	164	82
	Dimondale	Thursday, Jan. 6	229	114
	Eaton Rapids	Friday, Jan. 7	697	232
	Olivet	Saturday, Jan. 8	1,182	394
For county			2,335	212
Genesee*	Mundy	Friday, Jan. 7	1,275	425
For county			1,275	425
Gratiot	Forest Hill	Monday, Jan. 17	750	250
	Elwell	Tuesday, Jan 18	400	200
	Lafayette	Wednesday, Jan. 19	500	250
	Washington Centre	Thursday, Jan. 20	87	43
	Fulton Centre	Friday, Jan. 21,	525	262
For county			2,262	206
Hillsdale	Allen	Monday, Dec. 6	390	130
	Camden	Tuesday, Dec. 7	650	217
	Shadyside	Wednesday, Dec. 8	365	122
	Church	Thursday, Dec. 9	500	167
For county			1,905	158
Huron	Sand Beach	Tuesday, Jan. 4	501	167
	Port Austin	Wednesday, Jan. 5	190	95
	Pinebog	Thursday, Jan. 6	476	159
	Pigeon	Friday, Jan 7	105	105
	Sheridan	Saturday, Jan. 8	114	57
For county			1,386	126

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* Meetings were planned at Montrose and Mt. Morris, but failed to materialize on account of neglect of local authorities.

LIST OF WINTER ONE-DAY INSTITUTES FOR 1897-8.—CONTINUED.

County.	Places	Dates.	Attendance.	
			Total.	Average per session.
Isabella	Gilmore	Tuesday, Dec. 14	200	100
	Weidman	Wednesday, Dec. 15	60	60
	Shepherd	Thursday, Dec. 16	425	142
For county			685	114
Jackson	Springport	Tuesday, Jan. 18	1,090	363
	Rives Junction	Wednesday, Jan. 19	300	150
	Munith	Thursday, Jan. 20	170	170
	Norvell	Friday, Jan. 21	550	183
For county			2,110	234
Livingston	Fowlerville	Thursday, Jan. 6	500	250
	Pinckney	Friday, Jan. 7	540	270
	Brighton	Saturday, Jan. 8	560	280
For county			1,600	267
Mecosta	Remus	Monday, Dec. 20	261	130
For county			261	130
Montcalm	Gowen	Tuesday, Dec. 7	145	73
	Coral	Wednesday, Dec. 8	335	112
	Amble	Thursday, Dec 9	105	53
	Six Lakes	Friday, Dec. 10	100	50
	Entrican	Saturday, Dec. 11	150	75
For county			835	76
Newaygo	Hesperia	Thursday, Dec. 2	110	55
	Ensley	Saturday, Dec. 4	70	35
For county			180	45
Oakland	South Lyon	Monday, Jan. 10	935	312
	Farmington	Tuesday, Jan 11	475	237
	Pontiac	Wednesday, Jan. 12	950	317
	Rochester	Thursday, Jan. 13	725	242
	Holly	Friday, Jan. 14	985	328
For county			4,070	291
Ottawa	Hudsonville	Monday, Dec 13	127	63
	Jamestown	Tuesday, Dec 14	200	100
	Coopersville	Thursday, Dec. 16	255	127
	Olive Center	Friday, Dec. 17	110	55
For county			692	86

LIST OF WINTER ONE-DAY INSTITUTES FOR 1897-8.—CONCLUDED.

County.	Places.	Dates.	Attendance.	
			Total.	Average per session.
Shiawassee	Bennington Carland Henderson	Tuesday, Dec. 7 Wednesday, Dec. 8 Thursday, Dec. 9	160 60 300	80 30 100
For county			520	74
St. Clair	Capac Avoca Lambs Adair St. Clair	Tuesday, Jan. 4 Wednesday, Jan. 5 Thursday, Jan. 6 Friday, Jan. 7 Saturday, Jan. 8	617 775 710 367 226	2 258 237 122 113
For county			2,695	192
St. Joseph	Mendon Colon	Friday, Jan. 14 Saturday, Jan. 15	525 200	175 100
For county			725	145
Washtenaw	Chelsea Webster Salem Augusta	Tuesday, Jan. 11 Wednesday, Jan. 12 Thursday, Jan. 13 Friday, Jan. 14	776 304 582 344	259 101 194 172
For county			2,006	182

THE WOMEN'S SECTION.

The Women's Section was continued in about the same lines as the previous season. The chief change in plans was to request each County Institute Society to appoint a committee of women to take charge of the Women's Section. We secured the name and address of the Chairman of this committee, and corresponded directly with her in regard to the details of the Section. There is no question but this was a wise move. Details were much better looked after than ever before; the women felt that they were responsible for the success of the Section; and, besides that, we had a better means of knowing the exact feeling of the women themselves as to the needs of the Women's Section.

A report was secured from each Chairman. From these reports it appears that about 60 per cent of the women attending these Women's Sections were farm women. It is not to be regretted in the least that the proportion of town and village women was so large as 40 per cent, for we feel certain that one great work that the Women's Section is doing is the bringing together of the town and country women on an intellectual and social equality. If the Women's Section does no more than this it will be justified.

DO THE WOMEN WANT THE WOMEN'S SECTION?

Both the State speaker sent to the Women's Section and the Chairman of the same were asked the question: "Do the women of this locality wish the Women's Section continued?" In most cases an actual vote was taken. An examination of the replies to this question shows that out of all the counties where Women's Sections were held last winter only two report that the women do not wish the Section continued. In all the other counties the replies indicated that the women voted decidedly in the affirmative for the continuance of the Women's Section, and in many cases the vote for it was unanimous and enthusiastic. We do not wish to force Women's Sections upon any Institute, but so long as the women themselves desire these meetings they can have them. When the majority of the women express a wish that the Women's Section be omitted, it will be time to consider its discontinuance. But we have every reason to believe that the Women's Section in Michigan Institute work has come to stay, that it has a valid excuse, and that it is doing a work that not only could not be done in any other way in the Institutes, but also a work that is not being done by any other means in existence at present.

Following is a table showing the places where meetings were held, and the attendance. The attendance is slightly in excess of the attendance at Women's Sections a year ago. Conductors report that about 30 per cent of the attendance at the regular sessions of the County Institutes was composed of women:

WOMEN'S SECTIONS AT FARMERS' INSTITUTES, 1897-8.

County.	Place.	Attendance.
Alcona	Harrisville	86
Allegan	Otsego	179
Alpena	Alpena	16
Antrim	Central Lake	15
Arenac	Omer	86
Barry	Delton	131
Bay	Essexville	49
Benzie	Frankfort	73
Berrien	Berrien Springs	275
Branch	Coldwater	796
Calhoun	Burlington	150
Cass	Dowagiac	300
Charlevoix	Charlevoix	58
Cheboygan	Cheboygan	†
Chippewa	Pickford	36
Clinton	Elsie	110
Crawford	Grayling	47
Eaton	Charlotte	127
Genesee	Davison	355
Gladwin	Gladwin	97
Grand Traverse	Traverse City	68
Gratiot	Ithaca	150
Hillsdale	Reading	350
Huron	Bad Axe	171
Ingham	Mason	‡140
Iosco	Tawas City	48
Iron	Iron River	58
Isabella	Mt. Pleasant	140
Jackson	Hanover	404
Kalkaska	South Boardman	50
Lake	Luther	30
Lapeer	North Branch	†
Livingston	Howell	146
Macomb	Romeo	250
Manistee	Onekama	68
Mason	Ludington	70
Mecosta	Big Rapids	35
Menominee	Stephenson	198
Midland	Midland	84
Missaukee	Lake City	40
Monroe	Dundee	110
Montcalm	Sheridan	112
Muskegon	Montague	127
Newaygo	Grant	65
Oakland	Oxford	150
Oceana	Hart	175
Ogemaw	West Branch	112
Ontonagon	Rockland	38
Osceola	LeRoy	60
Oscoda	Mio	60
Otsego	Vanderbilt	80
Ottawa	Holland	100
Saginaw	Freeland	159
Sanilac	Carsonville	77
Shiawassee	Owosso	200
St Clair	Smiths Creek	125
St Joseph	Sturgis	275
Washtenaw	Manchester	179
Wayne	Wyandotte	93
Wexford	Manton	101
State Round-up	Agricultural College	*750
Total for State		8,705
Average per meeting		148

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† Women's section consolidated with main meeting, for local causes.
‡ Storm prevented arrival of State speaker.
* Three sessions.

ATTENDANCE AT FARMERS' INSTITUTES.

The following is a table giving the summary of statistics regarding Farmers' Institute work during the past year. These reports are according to figures furnished us by the Conductors in the case of the County Institutes, and by the State speakers in the case of the One-day Institutes. Especially at the One-day Institutes, the records of attendance sent by the State speakers and the Secretaries were practically alike. In a few cases, from the County meetings, the record of attendance sent by the Secretary varied from that sent by the Conductor. In former years these have often differed considerably, and we averaged them in making up the total attendance. However, the variance this year is much less, and hence we have taken the Conductor's count. In former years our only

METHOD OF COUNTING

has been to secure the *average per session* at each Institute. This, however, is not wholly satisfactory, inasmuch as it does not give totals. Therefore this year we give, in computations of attendance, the *highest attendance at any one session* of the Institute. This count gives a very conservative estimate of the actual number of different people reached by any one meeting, or by a series of meetings. And yet this is not quite adequate for purposes of comparison—for one Institute may have one session that is enormously large, because of some special attraction, while the general average is below some other Institute that has good attendance at every session. Hence we also give the *total attendance at all sessions* of all Institutes. We do not pretend that this is a basis for computing the number of people reached, but as between different Institutes, different counties, the work of different years in the same localities, and for purposes of comparing with work in other states, this, perhaps, is the best method of computation.

We devote considerable space to this matter of attendance at Institutes largely because heretofore such statistics have been inadequate, and because it is really the only basis we have for determining the work accomplished in different parts of the State under different conditions, and also of showing the scope of the work as a whole.

It will be seen that the total attendance the past season was 118,692. The figures for three years are as follows:

1895-6	96,122
1896-7	84,061
1897-8	118,692

SUMMARY OF ATTENDANCE

AT

FARMERS' INSTITUTES 1897-8.

County.	County institutes.					One-day institutes.			All institutes.	
	Total, all sessions.	Average per session.	Highest any session.	Women's section.	Members.	Total, all sessions.	Highest any session.[3]	Average per session.	Total.	Highest.
Alcona	741	123	218	86	46	-----	-----	-----	741	218
Alger	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Allegan	2,023	404	566	179	113	-----	-----	-----	2,023	566
Alpena	297	49	78	16	50	-----	-----	-----	297	78
Antrim	1,148	191	247	95	332	-----	-----	-----	1,148	247
Arenac	817	136	325	86	30	-----	-----	-----	817	325
Baraga	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Barry	910	182	250	131	73	-----	-----	-----	910	250
Bay	913	152	250	49	49	-----	-----	-----	913	250
Benzie	515	86	131	73	29	[2] 40	25	20	555	156
Berrien	3,185	531	875	275	262	2,030	1,050	156	5,215	1,925
Branch	2,371	474	1,196	796	130	-----	-----	-----	2,371	1,196
Calhoun	987	197	330	150	200	2,502	1,435	227	3,489	1,765
Cass	1,386	231	536	300	75	-----	-----	-----	1,386	536
Charlevoix	649	108	198	58	44	-----	-----	-----	649	198
Cheboygan	913	152	268	-----	145	-----	-----	-----	913	268
Chippewa	387	77	127	36	22	-----	-----	-----	387	127
Clare	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Clinton	1,473	245	395	110	82	-----	-----	-----	1,473	395
Crawford	495	83	237	47	44	-----	-----	-----	495	237
Delta	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Dickinson	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Eaton	2,182	364	557	127	-----	2,335	1,138	212	4,517	1,695
Emmet	627	125	175	-----	138	-----	-----	-----	627	175
Genesee	3,262	544	700	355	89	1,275	500	425	4,537	1,200
Gladwin	637	106	180	97	44	-----	-----	-----	637	180
Gogebic	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Grand Traverse	1,439	240	618	68	240	[2] 75	45	38	1,514	663
Gratiot	1,925	385	550	150	121	2,262	1,225	206	4,187	1,775
Hillsdale	2,105	351	675	350	290	1,905	800	158	4,010	1,475
Houghton	[1] 57	28	30	-----	-----	-----	-----	-----	57	30
Huron	2,319	386	620	171	261	1,386	919	126	3,705	1,539
Ingham	1,025	171	350	140	60	-----	-----	-----	1,025	350
Ionia	2,884	481	1,000	-----	161	-----	-----	-----	2,884	1,000
Iosco	706	118	228	48	35	-----	-----	-----	706	228

SUMMARY OF ATTENDANCE.—CONCLUDED.

County.	County institutes.					One-day institutes.			All institutes.	
	Total, all sessions.	Average per session.	Highest any session.	Women's section.	Members.	Total, all sessions.	Highest any session.	Average per session.	Total.	Highest.
Iron	319	80	142	58	35	--------	--------	--------	319	142
Isabella	1,363	273	385	140	72	685	345	114	2,048	730
Jackson	2,319	386	654	404	410	2,110	1,045	234	4,429	1,699
Kalamazoo	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Kalkaska	654	109	200	50	126	--------	--------	--------	654	200
Kent	1,785	162	300	--------	132	--------	--------	--------	1,785	300
Keweenaw	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Lake	315	79	150	30	22	[2] 245	142	82	560	292
Lapeer	860	172	200	--------	33	--------	--------	--------	860	200
Leelanau	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Lenawee	873	109	258	--------	--------	[2] 635	360	80	1,508	618
Livingston	1,936	323	400	146	155	1,600	1,175	267	3,536	1,575
Luce	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Mackinac	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Macomb	2,324	387	800	250	84	--------	--------	--------	2,324	800
Manistee	1,100	220	325	68	135	[2] 115	70	58	1,215	395
Marquette	326	82	118	--------	66	--------	--------	--------	326	118
Mason	569	95	166	70	102	--------	--------	--------	569	166
Mecosta	442	88	146	35	45	261	143	130	703	289
Menominee	1,208	201	325	198	22	--------	--------	--------	1,208	325
Midland	379	78	123	84	15	--------	--------	--------	379	123
Missaukee	255	64	125	40	--------	--------	--------	--------	255	125
Monroe	2,510	418	700	110	196	[2] 375	200	188	2,885	900
Montcalm	992	198	272	112	209	835	500	76	1,827	772
Montmorency	[1] 100	33	55	--------	--------	--------	--------	--------	100	55
Muskegon	1,692	282	402	127	67	--------	--------	--------	1,692	402
Newaygo	770	154	180	65	76	180	105	45	950	285
Oakland	1,323	220	395	150	334	4,070	1,875	291	5,393	2,270
Oceana	1,875	312	550	175	78	--------	--------	--------	1,875	550
Ogemaw	549	110	188	112	24	--------	--------	--------	549	188
Ontonagon	294	98	172	38	26	--------	--------	--------	294	172
Osceola	960	160	260	60	145	--------	--------	--------	960	260
Oscoda	366	61	107	60	31	--------	--------	--------	366	107
Otsego	685	114	225	80	46	--------	--------	--------	685	225
Ottawa	1,350	225	425	100	200	692	470	86	2,042	895
Presque Isle	[1] 20	20	20	--------	--------	--------	--------	--------	20	20
Roscommon	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Saginaw	1,915	383	650	150	102	--------	--------	--------	1,915	650
Sanilac	1,004	167	241	77	80	--------	--------	--------	1,004	241
Schoolcraft	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Shiawassee	2,720	453	700	200	83	520	355	74	3,240	1,055
St. Clair	1,706	284	625	125	183	2,695	1,158	192	4,401	1,783
St. Joseph	2,130	355	577	275	159	725	375	145	2,855	952
Tuscola	386	97	175	--------	79	--------	--------	--------	386	175
Van Buren	[1] 328	109	150	--------	65	--------	--------	--------	328	150
Washtenaw	1,201	200	349	179	211	2,006	938	182	3,207	1,287
Wayne	1,544	257	600	93	32	--------	--------	--------	1,544	600
Wexford	1,108	185	260	101	45	--------	--------	--------	1,108	260
State Round-up	4,200	467	700	750	--------	--------	--------	--------	4,200	700
Totals for State	87,153	14,990	25,705	8,705	7,080	31,559	16,393	3,812	118,692	40,998
Average	1,227	211	362	147	110	1,262	655	152	1,671	577

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[1] One-day meeting for county.

[2] Summer one-day institute.

[3] Figures in this column are found by adding together the highest attendance at any session of all meetings in the entire series of one-day institutes held in each county.

LECTURES AT FARMERS' INSTITUTES, 1897–8.

WITH TOPICS OF LECTURES.

We present below the names and addresses of persons who were sent by the Board as lectures to the various Institutes. We have also given their topics, thinking such information might be of assistance in the future to Secretaries of Institute Soceties in requesting topics or speakers, and also in arranging the local programs. We have divided the list of speakers into three classes:

I.

The following are regularly connected with the Agricultural College, and received *expenses only* while attending Institutes:

Prof. W. B. Barrows, Professor of Entomology and Zoölogy:
1—The relation of bees to the fertilization of flowers.
2—A few insect enemies of orchard fruits.
3—Some insects attacking small fruits.
4—The natural enemies of insects.

Dr. W. J. Beal, Professor of Botany and Forestry:
1—Diseases of orchard fruits.
2—Diseases of small fruits.
3—Nature study: An illustrated talk to young people.

M. W. Fulton, Assistant in Agriculture:
Soil moisture: A practical talk on proper cultivation.

Prof. W. O. Hedrick, Assistant Professor of History and Political Economy:
Taxation.

C. E. Marshall, Bacteriologist, Experiment Station:
1—Tuberculosis.
2—Dairy bacteriology (illustrated with stereopticon).

Prof. Edith McDermott, Professor of Domestic Economy:
Co-education at the Michigan Agricultural College.

Prof. H. W. Mumford, Assistant Professor of Agriculture:
1—Beef and pork for profit.
2—English farming.
3—The care of farm stock.
4—Fattening lambs.
5—Sheep for mutton: Their selection and care.

R. H. Pettit, Assistant Entomologist, Experiment Station:
1—Troublesome insects affecting market garden crops.
2—Some insects attacking our field crops.

Prof. C. D. Smith, Professor of Agriculture and Director of Experiment Station:
1—Stall fixtures and stall feeds.
2—Home dairy or factory, which?
3—Development of the dairy cow (illustrated with stereopticon).
4—The farmer's side of factory butter making.
5—Keeping up soil fertility.
6—The dairy herd—selection and care.
7—Home butter making.
8—Milk production for the cheese factory.

Dr. J. L. Snyder, President:
1—A trip to the Agricultural College. (Illustrated.)
2—Industrial education.

Prof. L. R. Taft, Professor of Horticulture:
1—Diseases of pome fruits.
2—Strawberries.
3—Diseases of stone fruits.
4—Raspberries and blackberries.
5—Diseases of small fruits.
6—Currants and gooseberries.
7—The treatment of plant diseases.
8—Grapes.

G. H. True, Instructor in Dairying:
1—The Babcock test and the eye in selecting dairy cows.
2—The relation of the Agricultural College to dairy prosperity.

Dr. Geo. A. Waterman, Professor of Veterinary Science:
A few hints on preventing diseases of farm animals.

Prof. C. F. Wheeler, Assistant Professor of Botany:
1—Weeds.
2—Smuts of grains.

II.

The following were employed especially for Institute work, and were paid a per diem and expenses while on such work:

Hon. Wm. Ball, Hamburg:
1—Selection and care of farm stock.
2—Keeping up soil fertility.
3—Business sense in farming.
4—Clean farming: A talk on weeds.
5—Up-to-date stock feeding for the general farmer.
6—Bean growing.
7—Success in feeding stock.
8—Value of improved stock and how to improve it.
9—How I grow corn.

J. H. Brown, Climax:
1—Soil manipulation in growing crops.
2—Self education in the farm home.
3—Farm sanitation and live stock sanitary laws.
4—The care of farm stock.
5—Profitable farm dairying.
6—Corn culture.

C. B. Charles, Bangor:
1—Underdraining.
2—Farm accounts.
3—Improving and utilizing low lands.

I. N. Cowdrey, Ithaca:
1—The rotation of crops.
2—Potatoes for market.
3—The hog as a mortgage lifter.
4—A garden for the farmer.

E. A. Croman, Grass Lake:
1—The creamery. From the farmer's standpoint.
2—Profit in hog raising.
3—Grasses and clovers for Michigan farmer.
4—Care of farm stock.

C. P. Goodrich, Ft. Atkinson, Wis.
1—The profitable cow.
2—Feeds and feeding for dairy cows.
3—Silos and silage.
4—The rotation of crops.
5—Manure value of different foods.
6—A talk to young farmers.
7—The making and selling of butter.
8—Corn culture.
9—The selection, feeding, and care of a small dairy herd.
10—Making and marketing butter.
11—The best method of caring for and using corn fodder.

Hon. R. D. Graham, Grand Rapids:
1—Elements of success with peaches and plums.
2—Apples and plums.
3—The value of farm organizations.

A. P. Gray, Archie:
1—The farmer's fruit garden.
2—Essentials of profitable apple growing.
3—Small fruits for market.

J. W. Hutchins, Hanover:
1—Everyday dairying for everyday farmers.
2—Maintaining mental fertility.

Mrs. Irma T. Jones, Lansing:
1—Whose image?
2—American womanhood: Its perils and its privileges.

R. M. Kellogg, Three Rivers:
1—Tillage as a factor in crop growing.
2—Big crops of small fruits.
3.—The farmer's fruit garden.

Mrs. Mattie A. Kennedy, Slocums:
1—Being a helpmeet.
2—The life we live.

Colon C. Lillie, Coopersville:
1—Keeping up soil fertility.
2—The home dairy.
3—Thoroughness in farming.
4—Up-to-date stock feeding and management.
5—Home dairy vs. the creamery.
6—The selection and care of the dairy herd.
7—Farm poultry.

Mrs. Mary A. Mayo, Battle Creek:
1—Mother and daughter.
2—Home life on the farm.
3—The unappreciated side of farm life.
4—The mother's greatest need.
5—The mother in her relation to the school.

Miss Louise Miller, Detroit:
1—Nature in relation to some problems in life.
2—Corn: A talk illustrating nature-study.

Roland Morrill, Benton Harbor:
1—Cultivation and pruning: Results illustrated.
2—Gathering, packing, and marketing fruit.
3—Business methods in farming.
4—The successful culture of apples and plums.
5—Spraying: Why, how, when?.
6—Small fruits for market.
7—Peaches and plums. ,
8—The home fruit garden.
9—Benefits of intensive cultivation.
10—The apple orchard.
11—Objects and methods of pruning.
12—Value of commercial fertilizers.
13—The horticultural situation.

A. E. Palmer, Kalkaska:
1—The home dairy.
2—Elements of successful farming in Northern Michigan.
3—The education of the farmer.
4—Soil fertility: How formed; how preserved.
5—Value of manures on sandy lands.
6—Silage and silos.
7—Summer feeding of dairy cattle.

L. J. Post, Lowell:
1—Keeping up soil fertility.
2—Orcharding for the northern counties.
3—Potato diseases and their treatment.
4—Commercial fertilizers.
5—The value and methods of spraying.

Mrs. Ella E. Rockwood, Flint:
1—Making the most of ourselves.
2—Fathers and sons: From a mother's standpoint.

J. N. Stearns, Kalamazoo:
1—Pruning, cultivating, fertilizing.
2—Making a market for fruit.
3—How shall we grade and pack our fruit?
4—Spraying and thinning fruit.
5—Starting right in fruit growing.
6—Successful orcharding in Southern Michigan.
7—Small fruits on the farm.

T. B. Terry, Hudson, Ohio:
1—Increasing fertility by clover growing.
2—Increasing fertility by tillage.
3—Manure saving. (Illustrated.)
4—The care of implements.

J. H. Vandervort, Hudson:
Fruit on the farm.
A. M. Welch, Ionia:
1—My experience with building and using silos.
2—Successful milk production.
3—Shall we buy or raise our cows?
4—Economical sheep feeding.
5—Winter feeding of cows with and without silage.

Jason Woodman, Paw Paw:
1—Cattle feeding: Its prospects and its practice.
2—Farmers' organizations: Their value and how to maintain them.

III.

The following members of State institutions and bureaus spoke at various Institutes, for expenses only:

FROM THE UNIVERSITY OF MICHIGAN.

Prof. H. S. Carhart, Professor of Physics:
Lightning and lightning rods.

Prof. M. E. Cooley, Professor of Mechanical Engineering:
The heating and ventilation of homes.

Prof. B. A. Hinsdale, Professor of the Science and the Art of Teaching:
Rural schools.

Prof. E. F. Johnson, Assistant Professor of Law:
Farming as a Profession.

Prof. F. R. Mechem, Tappan Professor of Law:
The relation of the corporation to the state.

Dr. F. G. Novy, Junior Professor of Hygiene and Physiological Chemistry:
Bacterial diseases of plants and animals.

Prof. J. E. Reighard, Professor of Zoölogy:
Some of the parasites affecting domestic animals.

Prof. V. M. Spalding, Professor of Botany:
Plant life as controlled by man.

Prof. F. M. Taylor, Junior Professor of Political Economy and Finance:
Who are producers?

Dr. V. C. Vaughn, Professor of Hygiene and Physiological Chemistry:
Hygiene and farm life.

FROM THE STATE BOARD OF HEALTH.

Dr. H. B. Baker, Secretary, Lansing:
How can we prevent the more serious diseases?

Prof. Delos Fall, Albion:
Prevention and restriction of communicable diseases.

Hon. Frank Wells, Lansing:
Prevention of the more serious diseases.

Dr. F. R. Belknap, Niles:
Some sanitary suggestions.

FROM THE DAIRY AND FOOD COMMISSION

Col. J. R. Bennett, Lansing:
Food adulterations.

FROM THE MICHIGAN GEOLOGICAL SURVEY.

Dr. A. C. Lane, Houghton:
Best farm water supply.

INSPECTOR OF ORCHARDS AND NURSERIES.

David W. Trine, Lansing:
Laws relating to diseases and pests of the orchards.

PRESIDENTS AND SECRETARIES OF COUNTY FARMERS' INSTITUTE SOCIETIES FOR 1897-8.

Counties.	President.	Address.	Secretary.	Address.
Alcona	Jos. Van Buskirk	Harrisville	Geo. W. Colwell	Harrisville.
Alger[1]				
Allegan	A. J. Bracelin	Allegan	E. J. French	Otsego
Alpena	E. O. Avery	Alpena	E. H. To nd	Ossineke.
Antrim	Philip Mudge	Eastport	C. E. Ramsay	Central Lake.
Arenac	Peter Gilbert	Sterling	Geo. W. Huckle	Omer.
Baraga[1]				
Barry	J. J. Perkins	Prairieville	J. M. Bauer	Hastings
Bay	L. W. Oviatt	North Williams	F. W. Dunham	West Bay City.
Benzie	Wm. G. Vorheis	S. Frankfort	R. B. Reynolds	Frankfort.
Berrien	R. V. Clark	Buchanan	W. H. Sei z	Royalton.
Branch	Abram L. Smith	Girard	A. L. Bowen	Quincy
Calhoun	. L. Harsh	Union City	J. M. Failing	Tekonsha.
Cass	J. W. Springsteen	Dowagiac	Robert Wiley	Dowagiac.
Charlevoix	M. M. Burnham	East Jordan	E. B. Ward	Charlevoix.
Cheboygan	P. L. Lapres	Cheboygan	C. F. Smith	Cheboygan.
Chippewa	E. C. Davidson	Rudyard	T. R. Easterday	Sault Ste Marie.
Clare[1]				
Clinton	Wm. Bird	Duplain	Geo. N. Ferry	St. Johns
Crawford	Oscar Palmer	Grayling	Henry Fu ck	Pere Cheney.
Delta[1]				
Dickinson	John Perkins	Norway	L. F. Springer	Norway.
Eaton[2]	Jas. H. Gallery.	Eaton Rapids	Geo. A. Perry	Charlotte.
Emmet	Wm. Atkins	Petoskey	E. A. Botsford	Petoskey.
Genesee	Geo. W. Stuart	Grand Blanc	H. L. Freeman	Flushing.
Gladwin	Frank Leonard	Gladwin	H. R. Clarke	Gladwin.
Gogebic[1]				
Grand Traverse	S. H. Say er	Yuba	E. O. Ladd.	Traverse City.
Gratiot	Jotham Allen	Ithaca	C. A. Van Deventer	Ithaca
Hillsdale	A. B. Cummins	Hillsdale	Earl H. Dresser	Jonesville.
Houghton[1]*	D. W. Sutter	Lake Linden	Correspondent.	
Huron	Richard Parr	Rescue	Mrs. Geo. Paugman	Verona Mills.
Ingham	W. H. Hewlett	Dansville	L. H. Ives	Mason
Ionia	Arthur P. Loomis	Ionia.	W. W. Bemis	Ionia
Iosco	John Preston	Tawas City	Geo. C. Anschuety.	Tawas City.
Iron	W. S. Greig	Iron River	P. O'Brien	Iron River.
Isabella	Wallace W. Preston	Mt. Pleasant	M. E. K ne	Mt. Pleasant.
Jackson	Ben F. Peckham	Parma	J. Weston Hutchins	Hanover
Kalamazoo[1]				
Kalkaska	A. E. Palmer	Kalkaska	James Greacen	Kalkaska.

PRESIDENTS AND SECRETARIES.—*Concluded.*

Counties.	President.	Address.	Secretary.	Address.
Kent	Wm. T. Adams	Grand Rapids	Wm. K. Munson	Grand Rapids.
Keweenaw [1]				
Lake	Ernest Nichoson	Luther	A. A. Miner	Luther.
Lapeer	W. W. Stickney	Lapeer	G. W. Carpenter	Lapeer.
Leelanau [1]				
Lenawee [2]	Geo. B. Horton	Fruit Ridge	H. H. Furguson	Adrian.
Livingston	J. B. Tazziman	Oak Grove	F. J. Fishbeck	Howell.
Luce [1]				
Mackinac [1]				
Macomb	John McKay	Romeo	Wm. M. Chapman	Romeo.
Manistee	A. W. Farr	Onekama	J. H. Read	Pomona.
Marquette	Robert Blemhuber	Marquette	Lewis J. Lavoy	Harvey.
Mason	John C. Griffin	Scottville	L. W. Bose	Wesley
Mecosta	Wm. Ladner	Big Rapids	D. W. Stewart	Big Rapids.
Menominee	Edward Sawbridge	Stephenson	Norwood Bowers	Stephenson.
Midland	James G. Culver	Midland	Frank H. Olmsted	Midland.
Missaukee	Harvey Bartholomew	Pioneer	D. D. Walton	Lake City.
Monroe	E. L. Lockwood	Petersburg	Henry H. Herkimer	Exeter.
Montcalm	John E. Taylor	Greenville	S. K. Marsh	Sheridan.
Montmorency [1]*	L. W. Ostrander	Atlanta	Correspondent	
Muskegon	J. J. Gee	Whitehall	A. B. Sumner	Montague.
Newaygo	Robert McKinley	Ashland	W. C. Stuart	Fremont.
Oakland	J. G. Noble	Oxford	James Y. Clark	Orion.
Oceana	F. J. Russell	Hart	W. N. Sayles	Hart.
Ogemaw	C. J. Phelps	West Branch	H. S. Karcher	Rose City.
Ontonagon	Jas. A. Crooker	Ontonagon	H. M. Powers	Ontonagon.
Osceola	B. G. Moulton	Leroy	S. Boroker	Leroy.
Oscoda	Stuart Gorton	Luzerne	Robert Kittle	Biggs.
Otsego	Joseph Glasson, Sr.	Gaylord	R. D. Bailey	Gaylord.
Ottawa	Geo. H. Souter	Holland	W. E. Bond	Holland.
Presque Isle [1]*	J. M. Clark	Adalaska	Correspondent	
Roscommon [3]				
Saginaw	H. M. Youmans	Bridgeport	J. A. Slocum	Saginaw, W. S.
Sanilac	Henry Oldfield	Port Sanilac	Henry Ruttle	Carsonville.
Schoolcraft [1]				
Shiawassee	James N. McBride	Burton	A. B. Cook	Owosso.
St. Clair	Charles S. King	Port Huron	James Dunn	Emmet.
St. Joseph	Comfort A. Tyler	Nottawa	Dison J. Porter	Three Rivers.
Tuscola	N. E. York	Millington	Fred H. Orr	Caro.
Van Buren [1]*	Davis Haven	Hartford	Correspondent	
Washtenaw	E. A. Nordman	Dexter	Henry Stumpenhusen	Rawsonville.
Wayne	P. B. Whitbeck	Plymouth	Herman Shoemaker	Wyandotte.
Wexford	Richard C. Norris	Cadillac	Elwood Peck	Cadillac.

[1] Counties not organized under law of 1895, May 1, 1897.

[2] County agricultural societies acting as Institute societies under the rules of the State Board of Agriculture.

[3] Failed to report, society discontinued.

* These counties organized no society, but under the law of 1897 were allowed an Institute of one day. The local secretary is designated as "Correspondent."

FINANCIAL STATEMENT.

FARMERS' INSTITUTE FUND FOR FISCAL YEAR ENDING JUNE 30, 1898.

Amount of Appropriation, $5,500.

Salary of superintendent		$600 00
Traveling expenses of superintendent		50 90
Salary of clerk		385 00
Salary of lecturers		1,840 50
Traveling expenses of lecturers		1,797 67
Printing		177 03
Stationery		67 62
Office postage		268 17
Mailing bulletins		104 00
Shipping bulletins, boxing, cartage, freight		26 50
Office supplies and apparatus		31 58
Lecturers' apparatus		29 30
Telegraph and telephone		3 56
Miscellaneous cartage, Lansing to College		20 60
Sundry		28 05
Farm Home Reading Circle	$94 52	
Credit	25 00	69 52
		$5,500 00

DETAILED STATEMENT OF SALARIES AND TRAVELING EXPENSES.

The following is a complete statement in detail of the pay and traveling expenses paid to each worker during the past year, giving the number of days and the amount per day:

Name.	Salary.			Travel.
	Time. Days.	Rate.	Amount.	
Baker, Dr. H. B.				$10 43
Ball, Wm.	42	$5 00	$210 00	102 82
Barrows, W. B.				7 25
Bartlett, C S.	3		10 00	13 24
Belknap, Fred R.				2 10
Beal, W. J.				28 28
Brigham, J. H.				10 00
Brown, J. H.	27	4 00	108 00	89 14
Butterfield, I. H.				7 37
Carbart, H. S.				6 50
Charles, C. B.	18	3 50	63 00	89 47
Cooley, M. E.				6 35
Cowdrey, I. N.	16	4 00	64 00	63 36
Croman, E A.	26	3 50	91 00	106 14
Fall, Delos				3 69
Fulton, M. W.				9 15
Gibbons, Robt				4 60
Goodrich, C. P.	35	5 00	175 00	81 57
Graham, A. D.	8	4 00	32 00	25 26
Gray, A. P.	8	3 00	24 00	35 56
Hedrick, W. O.				4 05
Hinsdale, B. A				14 37
Hutchins, J. W.	6	3 00	18 00	17 33
Johnson, E. F.				7 33
Jones, Irma T.	8	3 00	24 00	21 60
Kellogg, R. M.	9	4 00	36 00	22 15
Kennedy, Mattie A.	16	3 00	48 00	67 78
			1 00	
Lane, A. C.				6 50
Lillie, C. C.	21	3 00	63 00	72 87
Novy, F. G.				3 12
Marshall, C. E.				5 37
Mayo, Mary A.	38	5 00	190 00	119 84
McDermott, E. F.				9 22
McKerrow, Geo.				12 00
Mechem, F. R.				8 07
Miller, Louise	3	3 00	9 00	10 45
Morrill, R.	36	5 00	180 00	180 93
Mumford, H. W.			25 00	28 71
Palmer, A. E	30	4 00	120 00	119 10
Perry, Belle M.	1	3 00	3 00	1 00
Pettit, R H.				18 59
Porter, W. H.				7 50
Post, L. J.	16	3 00	48 00	43 40
Reighard, Jacob				5 95
Rockwood, Ella E.	17	3 00	51 00	42 45
Smith, C D.				25 75
Snyder, J. L.				29 87
Spaulding, V. M.				4 65
Stearns, J. N.	19	4 00	76 00	56 47
Taft, L. R.				35 60
Taylor, F M.				9 03
Terry, T. B.	28	5 00	140 00	56 25
True, G. H.				9 85
Vandervort, J. H.	4	3 00	12 00	21 63
Vaughn, V. C.				1 90
Waterman, Geo. A.				15 36
Welch, A. M.	3	3 50	10 50	7 42
Wells, Frank				2 65
Wheeler, C. F.				26 25
Woodman, Jason	3	3 00	9 00	11 85
Woodworth, P. B.				3 00
			$1,840 50	$1,797 67
	Month.			
Butterfield, K L., Superintendent	12	$50 00	$600 00	$50 90
Kellum, L. D., Clerk	7	30 00	210 00	
	5	35 00	175 00	
Total			$2,825 50	$1,848 57

COMMENCEMENT, JUNE, 1898.

EXERCISES OF THE WEEK.

Friday, June 10th, 8 p. m.

Contest in oratory among representatives of college literary organizations.

PROGRAM.

"The Slavery of the Present Day".............T. L. Hankinson, Columbian Society
"The Dawn of the Morning"...............Miss Bertha Malone, Feronian Society
"Deep Waterways to the Sea"................Allan H. Stone, Hesperian Society
"Lynchings"...........................Albert M. Patriarche, Olympic Society
"Woman's Work and Education"............Miss Coral Havens, Themian Society
"The Spirit of Discontent a Factor in Progress"........................
................................F. W. Robinson, Union Literary Society

Sunday, June 12th, 2:30 p. m.

Baccalaureate sermon by Rev. David McAllister, D. D., of Pittsburg, Pa. Subject, "Elements of Christian Patriotism."

Tuesday, June 14th, 8 p. m.

Senior Class-Day Banquet.

Wednesday, June 15th, Review of the Battalion, 3 p. m.

Reunion of College Literary Organizations in their rooms, 8 p. m.

Thursday, June 16th, 8 p. m.

President's Reception.

Friday, June 17th, Commencement Day.

PROGRAM.

Invocation.. Rev. C. L. Seasholes
Piano Solo...Mrs. Maud A. Marshall
Address—"The Influence of Bessemer"........................Frank V. Warren

Representing the Mechanical Course.

Address—"Development of Markets"................................D. J. Hale

Representing the Agricultural Course.

Address—"The Realm of Woman"..........................Miss Pearl Kedzie

Representing the Women's Course.

Music—Piano Quartette............Misses Bach, Bohn, Phelps and Fay Wheeler
Address—"The Economic Significance of a Technical Education"...........
................Prof. F. R. Hatton, M. E., Ph. D., of Columbia College, N. Y.
Music—Vocal Quartette..........Messrs. Calkins, Hale, Patriarche and Robinson

Dr. Edwards presented to F. W. Robison, '98 of the Union Literary Society, a handsome set of Larned's History of Ready Reference" as an award for being best orator in the College Oratorical Contest, held June 10th.

President Snyder then gave a short address to the graduating class and on behalf of the faculty and Board of Agriculture conferred the degree of Bachelor of Science upon each whose name here appears:

Bertha Baker,
Mary Baker,
Jennette Carpenter,
T. A. Chittenden,
E. A. Calkins,
George Campbell,
C. A. Gower,
H. A. Hagadorn,
D. J. Hale,
T. J. Hankinson,
E. Pearl Kedzie,
W. J. Merkel,
H. L. Mills,
R. E. Morrow,
A. M. Patriarche,
George Richmond,
F. W. Robison,
Dewey A. Seeley,
H. C. Skeels,
O. W. Slayton,
Clara M. Steele,
Charles Townsend,
F. V. Warren,
Catherine Watkins,
F. T. Williams,
F. T. Woodworth.

The degree of Master of Science was conferred upon Victor H. Lowe, '91, and Amy B. Vaughn, '97; and the degree of Doctor of Science upon Dr. R. C. Kedzie.

THE ECONOMIC SIGNIFICANCE OF TECHNICAL EDUCATION.

BY F. R. HUTTON, M. E., PH. D. OF COLUMBIA COLLEGE, NEW YORK.

It gives me great pleasure, ladies and gentlemen and graduates of the Michigan Agricultural College, to be the choice of your President for the opportunities of this occasion. I bring you today not only the salutations from an Eastern sister in education on the seaboard, but I bring you these salutations at a period of signal significance in the history of our great country. I come to you at a time when America, as these United States stand for it, has been brought by the successes achieved by its agriculture on the one side and its engineering on the other—and your institution stands for the progress of America upon both of these foundations—to a point where the responsibility has been forced upon us by the governance of a higher power to bear a hand in the solving of the world problem of development and civilization. We are an industrial and commercial nation, whose strength and whose interest lie in world-wide peace. And yet, almost in our own despite, we have had to take our share to bring about the transition from the mediaevalism of provincial mismanagement and abuse inherited under the feudal system and help to usher in the new era which dawns when the period of national home-rule begins under conscientious and faithful captains of industry.

It may be remembered that at the Golden Gate which entered the building of the Chicago Exposition, devoted to the appliances for transportation, there were to be found these pregnant words, quoted from Lord Bacon: "There are three things which make a nation great and prosperous: A fertile land; busy work shops, and free transportation of men and things from place to place."

I may be permitted, with a genial recognition of its possible bearing upon your policy, to call your attention, Mr. President and members of the Board, to the fact that Lord Bacon attributes prosperity to two parts engineering and one part agriculture; but, however the real facts of the case may be, his words might almost serve as a text from which I draw the inspiration of what I shall say in the few minutes allotted to me.

It is in this view that I venture to head my address with the title, "The Economic Significance of Technical Education." It is because I wish to bring home to you the vital relations between the material prosperity and wealth of a district, or a State, or a nation, and the proper provisions for the education of its youth in technical matters, or the application of science to the avocations of our lives. It is in this view that I turn with admiration and respect to those wise founders of your commonwealth, who felt with an intuition which perhaps they could not have explained or justified at that time, that the foundation of your College had much to do with the prosperity and stability of the State into whose constitution they inwrought it.

It is in this view that I address you, young men and young women graduates of today, because you are rightly to be regarded from this day on as the trustees of your Alma Mater as respects her repute in the community. You have it in your hands to make or to mar the opinion in which she shall be held. This is apparent, first, when you consider that by your future work will her usefulness be judged; but more than that I want you to leave her halls with an enthusiasm for her and for her work which shall be felt wherever you may be. I shall have secured my purpose if I can implant in your minds a respectful and well grounded affection which shall be different from that baseless feeling which makes college men "root" for their college, right or wrong. You have perhaps heard of the man who thought so well of himself that he lifted his hat whenever he heard his own name mentioned. I covet for you the possession of a deeper and more premanent esteem. I would like to have you carry away a memory from your commencement day, even if it must be impersonal to myself; that you heard a possibly gifted, but surely prosy person, who showed conclusively that the M. A. C. had a good reason for being.

It is almost a platitude of the commencement platform to refer to the necessity of education for the conduct of "A government of the people by the people and for the people," as the great Lincoln put it, and to repeat with sereme solemnity that "Knowledge is power." And yet it will be of service I am sure if you will allow me to assume this accepted truth, and carry your thoughts a few steps further in lines to which perhaps you are not so well accustomed.

I want to call your attention to the fact that when we consider as settled and satisfactory the work of the primary and secondary schools, in which department labor the great public schools of your State in their grades of grammar and high school, we have settled the question as to the boyhood and girlhood of our State, and have well treated the question of fundamental education before the question of the life work of the boy or girl is to be faced in his home. We have had our boy or girl at school well into his teens—say till sixteen—but the high school is done with him, and he must be entering into that shadow of future responsibility which makes these years so full of interest and of promise if they are rightly treated. We face, then, as educators and as thinkers on these questions, the problem of the man and the woman—not the simpler one of the boy and the girl—and the State has too vital a stake in the matter to be indifferent or careless as to the result. If we turn back to study the lesson of history on these questions, we shall find that up to the period of the Civil War of 1861-65. society offered two alternatives in most walks of life. The young man was either apprenticed to a master to learn his trade or calling, or he went to a college or university with a view to further culture if he could afford it. I am speaking of the condition in England in the time when Dickens wrote, when doctors graduated from the mortar and pestle, and lawyers entered the labyrinth of technicalities by serving as clerks and copyists of forms. There were faculties of law and medicine in a few European centres of university life—notably German—and a consecrated young man might enter the church through the classical university course which led him to his theological seminary. But at the period of which I speak, by far the greater number entered their life-work through the apprentice system in some of its forms. The university life was for the leisured class—the wealthy, the highborn, the nobility, the aristocracy, the few. The needs of the many were as yet unconsidered.

I need not stop long to point out the origin of this apprentice system, and the relation of master and learner. It runs deep into our inheritance of chivalry, and our histories and romances and ballads are full of the lives where the noble scion of a lordly house learned his arts of war and sport and deportment by serving as page and squire until he won his spurs as knight. It belongs, however, to the feudal period, and to a somewhat inflexible social order which is not that under which we breathe freely. It belongs to the time in which war was still the accepted path to preferment and worldly success, and the history of the king and his nobles is the history of the campaigns which they led, either as depredators themselves, or as defenders against the encroachments of others. It is a period of lower standards in every department, except those of literature and physical prowess—observe the suggestiveness of the union—when medicine was outgrowing herb-simples and contageous disease was still a divine visitation. We say our trade-unions are responsible for the disappearance of the apprentice system in industrial life. I believe the explanation is deeper and wider than that, and that in the economy of our brightr day its disappearance is not to be mourned as an unmitigated sorrow.

There are also many of us—too many of us—who have never out-grown our inherited notion as to the place of the university under that older atmosphere. Our sons must be toilers amid practical affairs—not dreamers in cloisters, nor hair-splitting controversialists, nor any variety of the mere talker about abstractions. Hence, think we, we have no need of a school after the high school, and our State has done its full duty by us when this opportunity has been provided for our sons.

My friends, this is not so.

The first group to separate itself from the apprentice system was naturally that in which fell the experts in military and naval matters. It was early appreciated that for the conduct of modern warfare training different from that then procurable at the universities was called for, and one which yet should be no less exacting along the lines of mental culture. Here the French have been our leaders in matters military, and

England the leader in matters maritime. Our schools at West Point and Annapolis are governmental colleges and were the first break in the old tradition. But they were a most significant one. Their establishment, their popularity, their success, the standing of their graduates in the community, broke the ice of conversation which had crusted around the idea, that on the one side stood the cultured few with an inheritance in literature, in theology, in jurisprudence, in philosophy, and in a narrow range of science, while over against them upon the other side were all those who were in touch with the realities of existence, the producers, the creators of things.

We must make up our minds which of the two views we shall hold, or rather to which of two desirable things we shall give the preference. We can regard our college or university as a center of personal culture, or we may regard it as an emporium of learning. Me may combine these two ideas in one place, as in your own State University, but it is but rarely that it is given to one man to combine in himself the best results of the two ideals. The two objects cannot be well sought together or at the same time; usually they are sought in succession—and happy the man who by frugality or industry or by fortune can have the opportunity laid before him.

For while we would like to believe otherwise, and to fancy like the ostrich with its eyes concealed that a disliked something is not near because we do not see it for the moment, yet in fairness it must be admitted that taking a country over or a State, it must be a fortunate few for whom the trend of their education does not have to have an immediate and practical bearing upon their life-work as bread-winners or as producers for the benefit of others dependent upon them. It is the *time required* in proper preparation beforehand and in the postponement of the beginnings of productive work which form the barriers, and not our theories, our wishes, or even our ambitions. All men are born free and equal before the law, but all men are not equal in endowment, and to try and make them so is a rainbow-dream.

How, then, is this acquirement to be met in a modern state? I answer the Michigan Agricultural College exists to meet it. What I believe in our modern conditions is the great need of the community is the proper and effective education of the many who must be producers in their several industrial vocations, that the capacities and resources of the State may be effectually utilized. For comfort in a community and the prosperity of which wealth is the measure is to a degree a matter of relation. Our ideals of natural prosperity are not those of the pre-revolutionary period in France, or even of some parts of Europe today—where there is unnecessary luxury and idleness for a few and after a great gap, a dispirited, discontended incapable many who are so near starvation that but a few days or even hours of sickness or inability to work will land them there. Or, to put the idea otherwise, we may measure our wealth and our prosperity in a state by comparing the condition as to comfort and outward civilization with us, or the measure of privation which must be endured by the most poorly paid grade of labor, with the same class in some other community. In other words it is not the few, but the many who are the index of prosperity. It is the amount on deposit in your savings banks which measures the intervals between present comfort and imminent suffering when wage-earning must stop, from sickness or temporary industrial derangement or from death. And if therefore it be conceded that the education in such a college as this is intended to make its students and graduates more capable of that historic achievement of two blades of grass; or more capable of manufacturing a desirable article cheaply so as to bring its purchase within the reach of a greater number of citizens, then I claim for it an economic significance and a necessity for its existence in the commonwealth which is not to be disputed. For it is to this point that I have been seeking step by step to lead you. If I can impress upon you my argument, I shall be well content. I recapitulate it in this form:

1. A community is prosperous when it is busy and every one can find paying work.
2. A busy community earning money can afford to buy things, which others have to sell.
3. A community can only afford to be busy when it can produce its products at a price less than these products can be brought in to it from outside.
4. Cheap production is a result of knowledge as to what is to be done and how to do it, with a combination of industry, frugality and sound judgment in the man who has the knowledge.
5. The technical school which furnishes both the knowledge and the character training is the foundation of cheap production, on which rests the busyness of the community on which rests its prosperity, its wealth, its opportunities for wider culture, its happiness, its devotion to art and æsthetic development, its realization of its highest ideals.

To give point to these contentions may I be permitted an illustrative story.

In the neighborhood of the town of Union, S. C., farming land had little or no value and could scarcely be sold. The people were poor, there was but little money in the community, and they did without things. It occurred to a far-seeing mechanical engineer that if a cotton mill could be erected in that place to avail of a water power which could be erected in that place to avail of a water power which could be electrically transmitted to the town, there would be at once created a call for labor to operate the mill and it could dispose of its own product in its immediate neighborhood at first, with a view to outer markets later.

At present there are two mills, one having a pay roll of $15,000 a month, and the smaller one of $5,000 a month. The $240,000 which comes into that town in pay rolls and is distributed among the population is expended in the purchase of farm products and the necessities for the workers, butter, eggs, cheese, meat and flour; land cannot now be bought, as it is so excellent an investment in the neighborhood of the town, by reason of its producing value, and an unhappy and discouraged community is a busy and happy one, because ability to earn has been put within its reach.

If my foregoing contentions are sound, they force upon us certain conclusions or deductions.

1. Michigan may well be proud of this school, by reason of its economic significance in the State.
2. It has a field of its own, distinct from that of the University, and while it would be a throwing away of opportunity to invade the field

of the latter on the one hand, it would be no less wasteful and unfortunate for the latter to feel an envy or jealousy as to the scope and field of this.

3. Bend your energies therefore to the development of courses of study having a direct relation to the life work of your students. There will be but one consulting engineer or chief engineer of a manufacturing corporation or a railroad, while there is room for a staff of assistant engineers in charge of departments, and an army of skilled workers. Labor for the good of the many, and leave the good of the few to others.

4. This is not a political platform, nor am I on the stump; but you will find that most mechanical engineers are moderate protectionists, and all agriculturists ought to be, because that national economic policy which induces a community to furnish opportunities for profitable labor in its midst is the policy which ought to bring prosperity in its train.

5. The educational policy of the state as respects its primary and secondary schools should be so moulded and directed as to favor the possibility of easy passage from high school to your doors. It is your school which is for the many, as is the fundamental purpose of your public school system. To educate a boy or a girl up to that point at which unrealized ambitions are fostered is a mistake, even a cruelty.

And, finally—

6. I said in glorification of the results of knowledge that these were to be applied in combination with a sound judgment and a strong character. The wisest of men saw the danger of mere ambition without the ballast to keep the well-sparred ship from keeling over much. And so, though I am not delivering a baccalaureate sermon, you will, perhaps, from its very unexpectedness remember the better in your future lives the wisdom of Solomon, when he said—"The fear of the Lord is the *beginning* of knowledge."

PRESIDENT SNYDER'S ADDRESS TO THE GRADUATES.

LADIES AND GENTLEMEN: You have now reached the end of your journey which seemed so long to you when you started four years ago. While many hardships and difficulties have been encountered, yet on the whole I believe it has been a pleasant journey to you, and I know that no one of you regrets the time and effort it has taken. On the other hand, you are to be congratulated on having successfully completed your course. You have had great opportunities, and you are to be commended for having had the energy and ability to take advantage of these as they came to you. But your success brings with it corresponding obligations. "To him that much hath been given, shall much also be required." Your nation and the commonwealth to which you belong have done much for you, and they have a right to expect much from you in return; not perhaps on the battle field, nor in a position of public trust, but in teaching the principles of true patriotic citizenship to all those with whom you may come in contact. They have a right to expect you to be model citizens in the fullest sense of the word, and to freely give to others of such knowledge as you have received here.

That you will meet their highest expectations we have every reason to believe from your success and deportment while in this College.

There are two thoughts that I would like to leave with you in parting:

First, Remember that there is very often but a slight difference between success and failure: only a small margin. A race is lost by a yard, by a foot or even by a single inch. One person may know but a very little more than his competitor yet that little places him in advance of his rival. It is a small margin but it brings success. In all lines of activity it is this small margin that wins. Let everything that you undertake be done ordinarily well, and then add a good margin and your efforts will be crowned with success. Keep a sharp lookout for this margin. By a little extra effort, by a little more courage and self denial keep it always on your side and you will succeed.

Remember also that there is but one road to success, and that is by honest, persistent effort. Success does not always mean wealth or distinction. Better have an approving conscience than high office or large possessions.

"We live in deeds, not years; in thoughts not breaths;
In fee ings, not in figures on a dial. He most lives
Who thinks most, feels the noblest, acts the best."

THE INFLUENCE OF BESSEMER.

COMMENCEMENT ADDRESS BY FRANK V. WARREN.

The Inventor is the greatest benefactor of the race. The greatest inventions are those which change most the economic, political and social aspect of the world. Foremost among the men who have exerted such a wonderful power in changing society is Sir Henry Bessemer, the perfector of the process for making steel which bears his name. He, perhaps, more than any other man has aided his nation and his race in its onward progress in wealth, comfort, safety and general prosperity; furnishing the material foundation upon which all moral and intellectual advances must ultimately rest.

Bessemer was an inventor from his youth, and the number and diversity of his schemes show his work not to be mere accident, but the result of a wonderfully power inventive mind and a nature of untiring energy. The failure to obtain the merited reward and fame from his earlier undertakings only increased in zeal. At the completion of each task he took up something new with a determination to master it, and bore with patient fortitude the prolonged interval which separated him from success. Having perfected a stamp which saved the British Government $500,000 annually, and for which he received not a farthing, Bessemer says of himself, "Sad and dispirited and with a burning sense of injustice overpowering all other feelings, I went my way from the stamp office, too proud to ask as a favor that which was indubitably my right, feeling that only increased exertions could make up for the loss of time and expenditure." But these early reverses only turned his inventive genius in new directions. While his inventions of type, bronze powder, high speed railway train, centrifugal pump, sugar separator, and plate glass polishing machine, would ordinarily make a man famous, they only served to prepare and educate Bessemer for his great master-work, the making of steel. By seven years of constant study and practical research, he developed his process from a mere abstract theory to such a degree of completeness that, notwithstanding the keen competition of rival manufacturers and the ceaseless activity and inventive talents of mechanical engineers the world over, his original process today is followed almost in every detail, as he dictated over forty years ago, and although another method is coming into public favor, there is made annually in the U. S. alone 5,000,000 tons of Bessemer steel.

The idea was suggested to him by an army officer, who remarked that stronger metal was necessary for guns. At that time Bessemer knew nothing of the iron or steel trade and very little of metallurgy, but his mind was unwedded to things as they existed, and in this spirit he began his investigations. One idea after another was put to the test of experiment, one furnace after another was pulled down, and numerous mechanical appliances were designed and tried in practice with only partial success until the labor and anxiety brought on a severe illness. While lying in bed he conceived the idea of a converter, and on regaining his health constructed one three feet in diameter and five feet high. The primitive apparatus being ready, the engine was made to force streams of air through the bottom of the vessel, the stoker poured in the moulten metal and instantly out came a dazzling volcanic eruption. The air cock to regulate the blast was beside the converter and no one dared go near it, but during their bewilderment the combustion ceased. The new metal was tried and its quality found good. The problem was solved; the age of iron was gone; the age of steel had come, and Henry Bessemer was king.

Certain it is that no event in the history of our time has more of the marvelous connected with it; none illustrates more strikingly the singular and impressive aspects of physical science; none is more far-reaching in its effects and none reveals a greater man, than this invention of Bessemer's. It takes rank with the great events which have changed the face of society since the time of the middle ages. The invention of printing, the construction of the magnetic compass, the discovery of America and the introduction of the steam engine are the only events which belong to the same category. It may be high praise to class this invention with these great achievements, but a candid survey of the situation leads us to the conclusion that no one of them has been more potent in preparing the way for the higher civilization which awaits the coming century. Its influence can now be traced and its future results are beyond the reach of the imagination.

It has contributed materially to lessen the severity of the sentence passed upon Adam, that he should eat his bread in the sweat of his brow. Men's muscles have been largely freed from wasting drudgery and are used only in healthy exercise. The sweat of the brain within the brow is now in a greater number of cases the true reading of man's destiny.

The fact that steel is now produced at a cost no greater than that of common iron has led to an enormous extension in its use and to a great reduction in the cost of the machinery which carries on the operations of society. The cost of constructing railways has been so greatly lessened as to permit of their extension into sparsely inhabited regions and the consequent occupation of distant territory otherwise beyond the reach of settlement. The cost of transportation has been reduced to so low a point as to bring into the markets of the world crude products which formerly would not bear removal and were thus excluded from the exchange of commerce. It is now possible to carry grain from the interior states to the seaboard so cheaply that it can be delivered in distant lands at a reasonable price. Fast ships are hurrying from San Francisco to India to feed the famine stricken ones of that land, and the Atlantic has been turned into a ferry, dotted with grain laden vessels crossing to supply the demand of European countries. Its effects can be traced still further. The competition of our western wheat regions made practically impossible the raising of wheat in the British Isles, and farmers who depended upon it could no longer pay the rent stipulated in the leases. As the aristocracy of Great Britain is a survival of previous conditions, depending for its existence upon the revenue derived from the ownership of land, a serious blow was struck at the privileged class of Great Britain, and while Bessemer may be inclined to disavow the claim, history will record the fact that he has been instrumental in reconstructing the British constitution upon the basis of universal suffrage.

On the sea the improvement has been as great as upon the land. The vast extensions and new directions of commerce which have resulted from the construction of steel vessels have converted the commercial world into a vast clearing house for the exchange of products. The balances are passed to the credit of each country in the general settlement, the functions of the precious metals are reduced and economy in exchange effected, due largely to improvement in transportation made possible by Henry Bessemer.

In accordance with the law of commerce, that nations cannot sell without buying, the imports of the United States have been largely increased, and under the fiscal system made necessary by the war for the Union, a revenue has been derived enabling us to reduce materially our National debt.

The great practical result of all this has been to reduce the value of the food products of the civilized world; and, inasmuch as cheap food is the basis of all industrial development and the necessary condition for the amelioration of humanity, the present generation has witnessed a general rise in the wages of labor accompanied by a fall in the price of the food which it consumes. In the essential elements of comfort, the working classes of our day are enabled to earn and expend double the amount which was at their command in any previous condition of the world, and this is due largely, if not altogether, to the economy in the agencies of production made by the cheap steel of the Bessemer process and the other inventions which have followed in its wake. These material results have been accompanied by the slow but sure elevation of the great masses of society to a higher plane of intelligence and aspiration, made evident by the association of working men together for the advancement of their moral and social condition. Good must come out of this tendency, and one of the chief glories of Bessemer is that he has contributed more than any other man to the condition of industry which compels all to combine on a scale unknown before in the work of economic production and distribution. The interdependence of the human race has thus been increased; the probability of hostile action by war diminished, and the name of Bessemer added to the honorable roll of those who have succeeded in spreading the gospel of "Peace on earth and good will toward men."

Is it any wonder that wealth, and glory and honor came to him from every land? England mourns for Gladstone, America reverences the name of Washington; Russia, Peter the Great; Germany loves Bismark; but the whole world owes a debt of gratitude to Henry Bessemer.

DEVELOPMENT OF MARKETS.

COMMENCEMENT ADDRESS BY D. J. HALE.

America has astonished the world by her immense industrial development during the last half-century. A goodly share of the credit for this success is due the farmer. To have peopled the board plains of the west, to have conquered a vast wilderness, and to have caused stubborn nature to yield the great staple food products in quantity sufficient to feed the people of this nation and several nations besides, is a very commonplace but a very substantial achievement of the American farmer. But nevertheless the farmer throughout the country begins to feel that this is for him but a defeat in victory. For though he expends costly energy of brain and brawn in raising immense crops, yet when he markets those crops he receives in return scarcely a livelihood. He knows that for some reason the markets are to blame, for those same products of his are valuable, not only in foreign countries but in many parts of the United States.

One great reason for the farmers' low prices and lack of prosperity is that the development of markets has not kept pace with increased production. Our farming industry, leaving the rock-bound and sterile East, for the fertile plains of the West, has become giant-like, while the East has become instead a thickly populated manufacturing district, whose hungry workmen demand the transportation of the Western food. For each of our seventy million people 5½ acres of land are tilled, while each person can consume, at most, the product of but 2½ acres. Then over half of our country's produce must, as surplus, be transported to Europe and marketed where food is scarce and high-priced.

An extensive and efficient market is then one of the farmer's greatest necessities. Its function is to first thoroughly distribute the farmer's great crops in the United States. It must ascertain and supply the varying demands of different sections, placing most where most is needed. Next, it should carefully study and supply the important foreign demand, strengthening old markets, opening new, to receive our great surplus.

In both these functions our middlemen, the boards of trade, commission merchants, and other organizations which manage our markets, fail. This can be partly accounted for in three ways.

First, They fail to accommodate production and consumption to each other because both vary from natural and uncertain causes. Production depends upon the number of acres of a crop planted and upon the presence or absence of drought, flood, and frost. But the acreage of crops has not yet been controlled, and to foretell the weather for more than 24 hours is beyond the power even of the weather bureau. On the other hand, consumption, not the desire but the power of the worker to buy, fluctuates with every great commercial crisis or unfavorable political measurer that closes the office, shop and factory. The plan and calculation of our farmer's market man is never in the least based upon the probabilities concerning these changes.

But the second great cause is the saleman's ignorance or carlessness. He never stops to think that the capricious market price, like uncertain weather, is controlled by great laws or that a given set of conditions will always give a like variation in price. Making no effort to systematize distribution or steady the market, each group of merchants desires only to buy cheap and sell dear. Without general system or foresight, produce is heaped into the large towns till the consumer is surfeited while small towns are thoroughly neglected. Often the actual cost of fruit, dairy products, or even staple foods, differ by one-third in a large town and a hamlet a few miles away.

This lack of care is further illustrated by the criticism of the United States Secretary of Agriculture, who says that the disposal of our surplus in foreign markets is mismanaged. When there is a large home crop the poorest of it is dumped as surplus into our foreign markets while with a normal crop these markets are entirely neglected. Canada, using more care, demands higher prices than does the United States in foreign markets. But the third and greatest cause of the mismanagement of our markets is the monoply or dishonesty of the two great controllers of the farmer's market—the means of distribution or the railroad, and the agents of distribution or the middleman as we see him in the board of trade and the commission merchant..

The railroad and elevator companies of the West are the only means by which the farmers' great crop, otherwise worthless, can be transported and distributed throughout the country. But the railroads are natural monopolies. They seldom compete for the farmer's produce but uniting with each other and the elevator companies, raise the rates so high that the farmer, who must ship, is robbed of nearly all his profits. One the one hand railroads will discriminate in favor of a great corporate manufacturing industry, but on the other, have no fear of the single-handed farmer. Before any reform in the market themselves can take place, these silent filchings from the farmer's purse must be stopped and some magic charm must force the railroad monoply to give the farmer's produce good rates and the best connection for thorough distribution.

But fully as detrimental to the farmer is the dishonesty and monopoly of our agents of distribution. Of these middlemen who are responsible for the farmer's markets there are two classes, the boards of trade and the commission merchants who are especially unfair to farmer and consumer as well. A board of trade in Chicago is organized for handling wheat, for instance, at the greatest profit. The wheat is consigned by western elevator companies to a broker in Chicago, is shipped to him and there stored to await distribution over the country. But without touching the wheat the broker sells the ownership to another at a profit and so on to another till all possible profit is wrung from it. Or else several make a corner, buying up all the wheat in the market and then disposing of it at immense profits. The wheat is finally reshipped to other points but at a cost that would be wealth to the farmer who raised it. Were it not for this ruinous monopoly our great staple foods could be distributed at a fraction of the present expense.

The second class of monopolists are the commission merchants and their associations, of Chicago especially. These business houses receive fruit from growers at a distance and having sold it, are supposed to remit the sum excepting the freight and their 10 per cent. commission. Sometimes a suspicious fruit grower not only ships his fruit but accompanies it to its destination, and, a complete stranger to the commission men, buys his own fruit, takes a purchaser's receipt, and quietly departs. At home again he receives as a fruit grower the commission man's bill of sale. The receipt of purchase often shows an excess of 25 or 50 per cent. over the bill of sale, showing that the commission merchant has pocketed much more than his 10 per cent.

To sum up the situation, we see that the total production varies on account of unfavorable seasons and differences in acreage, that total consumption varies on account of great political or business crises. This natural difficulty is many times increased by the carelessness and lack of thoroughness of our middlemen. Finally, our tandem monopolies of means of transportation and agents of distribution completely ruin the soundness of our markets, defy all accurate calculations and make markets what they now are, arenas of chance for the merchant, the assurance of poverty to the farmer.

The only course under these circumstances left for the farmer is a necessity. He must control his own markets and make his own terms with the railroads.

And the most intelligent farmers are beginning to do this. Instead of shipping to overstocked cities they supply grocerymen in small towns; others deal directly with their customers, giving them better produce at less cost.

Fruit growers are perhaps succeeding best. Some shrewd men in our fruit belt are supplying Chicago fruit stands with best fruit at best prices. Several large fruit growers' associations in California are shipping fruit to large and small cities all over the United States, and sometimes even to Great Britain. Why should not the farmers deal successfully as have many other business interests or industries, which handle as great sums of money, and successfully support as great responsibilities? Our great factories have agencies of their own that sell their produce. They would not give railroads or middlemen the profits. Our giant insurance and loan associations are partnerships in which one man disposes of another's money for their mutual profit.

On such a plan two or a hundred farmers, the more the better, could associate in a lawful partnership. Several should be especially good business men with a large practical knowledge of markets. These specially fitted men could fill and more than fill the place of our middlemen. The association could better succeed in controlling than the individual farmer because today, as ever, union means strength. First, they could control the great prime cause that we have found disturbs our markets, i. e., supply and demand. They could build store-houses and store the nonperishable staple foods, giving to the market when needed, withholding the surplus of an immense harvest. In this way flour would not as now be $1 per sack one month and $2 the next. If associations combined they might ultimately control the number of acres of staple crops planted.

Secondly, They could do away with the ignorance and carelessness of the middleman. The fruit associations of California are now distributing the perishable fruit produce not only in large cities but in towns, doing the work more thoroughly and cheaply than it was ever done before. These associations, all working for the same end, would make an exact and efficient working knowledge of markets possible to farmers in general and would greatly systematize and steady our markets.

But the third and greatest difficulty, ruinous monopoly of means and agencies of distribution, would be largely overcome. While railroads pay little attention to the single farmer they become the obliging servant of a large association with a great producing power. The California fruit associations get the best rates, the swiftest and the best trains, and good connections by rail and steamships even to Breat Britian.

The control of staple food products would be the greatest monopoly in the world. The farmers could store and sell their own wheat and more thoroughly distribute their fruit at far less cost to both producer and consumer. Again, such associations could largely do away with the commission merchant and make their own terms with boards of trade.

To bring about these beneficial results the farmers of the country need first a thorough knowledge of markets. That they may intelligently fulfil their part in an association, they need a class of business men whose sympathies lie with the farmer, whose business ability is unquestioned. Second, They all need honesty. When their partnership makes a contract they must stand by it. In fact, the law may be invoked to hold them to it as in any partnership. They must also pack their fruit or other produce honestly, so that their association may be trusted by its patrons.

The farmer then must himself attend to the development of his own markets. He is bending labor, machinery, science and Yankee ingenuity to the task of growing two blades of grass where one grew while all the world of industries beyond him in development sneer at him because he does not better dispose of his one blade.

The whole trend of our industrial development is toward the business association of man and man, a greater inter-dependence of men and far grander industrial accomplishments. The farmer resists his own control of markets at his own peril. Unjust monopoly and mismanagement of markets threaten not only the farmer but the vast population which the farmer feeds. Not only his own just interest but those of the world demand that he arise to the emergency.

THE REALM OF WOMAN.

COMMENCEMENT ADDRESS BY PEARL KEDZIE.

If there is one word in the English language which is dearer to us than any other, that word is "home." It enshrines all that is most precious, that is most sacred to the human heart. The old adage, "home is home, be it ever so homely," appeals to all. From the camp of the savage under the open sky or the tiny cottage of the laborer to the magnificent palaces in our great cities—each one is a home with all its import. No man is poor who has still a spot to call home, and no man is rich who has no home.

The home is a necessity for the perfect life and development of good citizens. How can one describe it? It is there that the weary laborer finds rest and peace after the day's work. Under its shelter, the energies are refreshed for the coming day. Led by its guiding hand, the young lives which will some day be the world's rulers and toilers are brought to manhood and womanhood.

Because of the dear ones in that home, nobler motives arise and grander effort is put forth in the world's strife. There, those who sway the opinions of the country, who make and execute our laws, who lead armies into battle, are known at their best and purest. There, man is noblest and woman is loveliest. In the home—the society, the religion, and the civil polity of the future are formed. The home is the most perfect of schools, and so much depends upon it that "if this be right, nothing else can be wholly wrong; so much that if this be wrong, nothing else can be altogether right."

But what would be the picture of home without woman as its central figure? Woman has ever been the home-maker. It is her influence which is most felt, and it is in her power to make of home the happiest or the unhappiest spot on earth. From the beginning of time, woman has laid out her line of work and kept to it unremittingly. God has given her a character and a realm of her own with her special work to do. Yet it was only with the beginning of Christianity, that the ideal of womanhood was raised to its present exalted position. The life of the primitive woman was one of obscurity and darkness—her only future being a marriage, which meant only a life of slavery, and drudgery, and ignorance. Christianity has raised woman to what she is today—educated, refined, ennobled, working shoulder to shoulder with her brother in nearly every branch of labor. She occupies everywhere positions of honor and trust, but she fills no higher place in the world than that in her own home as queen over her own household.

Frances Willard has said, "If I were asked the mission of the ideal woman, I would reply, it is to make the whole world homelike. Home is woman's climate, her vital breath, her native air. A true woman carries home with her everywhere." What a gain to the race if the true woman brings the outside life into the home, and beautifies and ennobles it under the rosy hues of the home-life. What need is there for woman to go to the polls to bring purity into politics? If she would take the interests of the country's welfare into her home, and there interpret every event with personal interest and sympathy, how much more lasting would be her influence. Let the home be the bond of our nation's interest and our private welfare. Let the whole world be brought to the hearthstone, and so make of home the dynamic force for the advancement of the whole race and of future nations.

Knowing the influence of the home to be so powerful, can we give too much thought to perfecting it into an environment which shall give the conditions for the best development of our people? The needs of the home and the requirements of the housekeeper stand first in importance. For the demands of the household, who can be too well prepared? No doctor, or lawyer, or minister would think of making a place for himself in the world without years of study and training. If so much importance is given to the previous preparation of the professional man, what can be said of the necessity for the preparation of the professional woman, who undertakes the profession of housekeeping, which means the making of men strong to be good doctors, or lawyers, or ministers?

By far the greater proportion of the women of the world are daily performing household duties in their homes. Knowing it is the natural destiny of the normal girl to some day marry and make a home of her own, should every girl not feel that this is a definite line of work needing the most thorough preparation, and a calling than which there is no other more exalted or sacred? But whether she marry or not, every woman at some time in her life is called upon to do or direct household duties. As the profession of housekeeping is the most common one undertaken by woman, it stands to reason that her most thoughtful energies should be expended in preparation for it.

It has not been many years since a girl's education was thought to be completed with a knowledge of reading, writing, and arithmetic, together with what was termed the accomplishments, consisting of a little French, painting, and music. Mankind has at last awakened to the real needs of the woman's education. Now, beyond the accomplishments and elementary learning, the highest and best that education can offer is not considered too good for her. More is expected of the woman of today than ever before. Her education must give her high ideals and practical habits which will enable her to fill any position which the coming century may bring. Some one has said: "Education, if it means anything, is the quickening of the powers that enable us to live—ideally, and practically, morally and mentally—or that give us the capacity to enjoy and expand this life."

The education of the girl of today may not train her for any special position in the world, but it aims to make of her the whole woman, whose influence shall be felt for good wherever she may be; and into whatever circumstances she may be thrown, the educated woman, and especially the woman with a practical education, is better equipped to meet life as it comes to her. Then it falls to her lot to become a home-maker, surely the best education, the most brilliant accomplishments, and the most charming personality are not too much to give to that home.

People are fast seeing that no education is complete which does not teach one how to live. The girl should be taught—besides sciences, languages, history and literature, those things which have a direct bearing upon the peace and comfort of every day. If mere intellectual training did this, there would be no need of manual training. But brain and hand must work together in harmony for the most perfect results. With science as the foundation, manual training becomes a help and not a hindrance to the intellect. To train a woman to be a housekeeper along with her other education, is not to narrow her sphere but to enlarge it. Whatever work she may afterwards undertake, will only be helped, because she has been made stronger for it; by the equal training of hand and mind.

If the woman nters the home after such a preparation, how much better will that home be than it ever could have been otherwise. If she is not called upon to do the work of the household herself, she will at least be able to direct her work with the surety of certain knowledge; but if she does do it herself, she will know how to do it with the best expenditure of time and strength, and make of her work not drudgery but pleasure. The need of an education for the home is often realized too late. We once heard a lady who was finely educated, but yet without practical training, and who had suddenly become mistress of a beautiful home in one of our large cities, say to her friends: "I would give all I know about Shakespeare to be able to tell what ails the bread when it isn't good."

Good housekeeping requires a knowledge of art and science; and to be a good housekeeper one must have a knowledge of cooking, chemistry, bacteriology, hygiene, handling of the needle, and countless other things; and as many of these courses as possible should take an important part in every girl's education.

The food consumed is very powerful in determining the character of the individual. If our people had better, more wholesome food, much of the unhappiness of this world would be lifted. Fewer men would depend upon their tobacco and liquor for the day's strength. With good bodily nourishment, health is always present, and with health—happiness. The opinion is too common that medicine alone is what is needed in disease, but science is now teaching that nutrition both as a cure and preventive is more important. The wise housekeeper will provide the kind of food that is needed by each member of the family to do his work in the best way, and make the body strong and able to endure. She will know that Heaven's gifts of air and sunshine are intended for use, and will not close windows and doors—shutting out purity and keeping in the germs of disease. She will also know the need of pure water. Then with good food, pure water, and plenty of air and sunshine, she has in her control preventives and cures more powerful and lasting than all medicines. On the other hand, she must have at least the elementary knowledge of the trained nurse, and in case of sickness or accident must know what to do and when to do it, for it may be that a life's thread will be snapped through her ignorance.

Economy and system are fundamental principles which must under-lie the management of any successful household. Every girl should understand the value of money, and know how to utilize the family income in the most perfect way to make the home beautiful and the lives of its inmates ones of pleasure and comfort. Great expense is not needed for an attractive home, but where there is an appreciation of beauty, the home may be made attractive and its furnishings in harmony. Whether or not the surroundings are harmonious has more influence on character than is usually considered. Beautiful environments cannot help but tend to make beautiful characters. The woman of culture will bring beauty and art into her home. Appreciation for the highest in painting, music, and literature will be fostered there, for she will realize their uplifting and ennobling influence upon the lives they touch.

Then realizing the influence of home—too deep and lasting for comprehension—is it not time that more earnest thought were given to making the home as faultless as it is in human control to do so? And as it has been given to woman to be the home-maker, it is her duty to be fully prepared in all lines which relate to it. When the importance of the home in the progress and development of the race is fully realized, then the science of house-keeping will be given an exalted place in every girl's education. When it is recognized as the best work to which woman aspires, because it is in the realm in which God intended her influence to be most potent, then will come to every home-maker the pride in work well done, and the knowledge that her profession is the profession without which there could be no other.

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THE STATE GRANGE.

WORTHY MASTER'S ADDRESS.

The annual meeting of the State Grange was held in the Capitol at Lansing, beginning December 14, 1897, at 9 o'clock a. m. One hundred and thirty delegates were in attendance. At the forenoon session the various committees were appointed.

At the afternoon session Master Geo. B. Horton delivered his annual address as follows:

To the voting members of the Michigan State Grange again I extend greeting.

From the fertile and undulated farms of a state that bears so appropriately the poetic title, "The beautiful peninsula of the inland seas," you have come to form a legislative body for the purpose of deliberating upon such questions as will assist in promoting the welfare of the order Patrons of Husbandry. An order which has existence but little past a quarter of a century, yet has done much for the farmer and his family by furnishing a medium through which they may work for almost innumerable benefits to themselves, their families and the business of farming. An order which has withstood the turbulent sea of experiment and is now strong in experience, rich in achievements, and offers a haven secure wherein the farmers of our country may prepare themselves to meet the demands of the present and of years to come.

You have left your homes for a time to meet in social intercourse, and thus, by seeing, knowing and hearing each other, your oneness of interest will be revealed, and co-operative lines of action developed to the end that you will be better farmers and home makers, will dignify labor, and increase its rewards, will understand the better your rights and duties as citizens, and how to act in their execution and maintenance. No worthier objects can call you together. I need not tell you that this medium of which I speak is the Grange, and that the local or subordinate organizations over all the state are now looking expectantly toward this place where you are assembled for the preparation of nutritious and digestible food for their sustenance during the coming year. It will not be wise to disappoint them. That they be not given a crust when much better and more is needed, calls for much earnest thought and wise council on your part.

The chief object of this communication is to lay before you the general condition of the order in the state, the work done during the past year, with such suggestions and recommendations as experience seems to dictate, to the end that you will not only know of my stewardship, but you will be better prepared to legislate for the future. The reports of the Worthies Secretary and Treasurer will tell you the exact condition of our treasury, and your Executive Committee will, no doubt, give you information along business lines and the Woman's Work Committee will tell you of work well done.

THE NATIONAL GRANGE.

The National Grange recently closed its thirty-first annual session at Harrisburg, Pennsylvania, and the session was considered of much value to the interests of the order at large. Three thousand dollars was placed at the disposal of the Executive Committee to be used in placing organizations in the weak and dormant states. Secretary Wilson, of the Agricultural Department at Washington, and now a member of the President's Cabinet, came on for the sole purpose of making the acquaintance of the National Grange and to pledge the best possible service at the command of the department to the interests of the farmers of the United States. All who saw and heard this staunch advocate of agricultural development were most favorably impressed. Secretary Wilson is a broad and strong minded man, imbued with intense honesty of purpose and thoroughly conversant with the importance and needs of agriculture. The National Grange flushed with pride and enthusiasm as the members recalled the first advocacy and continued demands by the National Grange, that the Agricultural Department at Washington be established independent of other departments, and given such breadth of responsibility as the importance of agriculture to the welfare of our country demanded, and then that its chief, the Secretary of Agriculture be made a member of the President's Cabinet, with powers equal to other cabinet officers. As the National Grange listened to Secretary Wilson, as he explained the many kinds of experiments, inquiry and actual work being done along lines calculated to diversify and assist production, expand and create markets for farm products, the National Grange felt that it now realized that which was but a dream, and that to have been the prime mover and chief supporter in a demand which has resulted so eminently helpful to our agricultural interests is one of its greatest achievements.

BUREAU OF INQUIRY.

As recent decisions seem, in effect, to nullify the "long and short haul" provisions of our Interstate Commerce laws, and as it often happens that the people in one part of our country would be consumers of the large surpluses that exist in other parts, but are prevented by excessive cost of transportation, it would be gratifying to know that by virtue of a resolution, passed by the National Grange, Secretary Wilson is to establish a bureau of inquiry for the purpose of collecting a record of conditions and facts from different parts of the country relative to the question of transportation, to be used as a basis upon which to ask of the government relief from these hinderances to production and consumption. In this the National Grange is again leading in an important matter.

BOUNTY OF EXPORTS.

It is the avowed policy of the National Grange to demand of the government a measure of benefit for agriculture, equal to that enjoyed by other interests because of whatever system of tariff is the adopted policy of the government. It is asserted by many farmers and especially those who live in the great agricultural West, that at the present time, the farmers are not receiving as good a measure of benefits from the system in operation, as do manufacturers and other interests, because, as they claim, the chief staples of agriculture are, a greater portion of the time, raised in surplus quantities, and as soon as any farm product is raised in excess of home demands, the surplus, if merchantable, must go abroad to find sale, and is sold in the foreign markets in competition with the cheap land and cheap labor countries of the world, and what the exporter pays for this surplus, although the surplus may be comparatively small in quantity, it fixes the price of the larger quantities of the same commodity that are sold on the home markets. Attention to this apparent injustice and the duty of the National Grange because of its expressed position on the tariff question was called by Mr. David Lubin, a gentleman of broad observation and experience, and who is devoting much time and means in travel to foreign countries for the study of economic conditions, and how they affect the people, and especially the agricultural producers of this country. Mr. Lubin, as is well known, advocates a system of export bounties to be paid by our government on such portions of our agricultural products as are exported. He asserts that the result of such bounty will be to raise the price of all such commodities as are sold on the home market, and thus establish equity and justice between the manufacturer and the farmer. Thus the farmer will, in turn, be able to buy of the manufacturer at the increased price, otherwise the farmer is compelled to sell cheap and buy dear, and this, he maintains, is what ails farming. This question comes repeatedly before the National Grange and has attracted considerable attention. The result, at the recent session, was that the President of the United States was petitioned to appoint a non-partisan commission and comprising representatives of the different productive and business interests of the country, to consider this question and to investigate the question of revenue and kindred subjects, to the end that they will be eliminated from partisan manipulation. I place the main features of the proposition before you for your consideration with the other economic questions of the day.

BUREAU OF INFORMATION.

In accordance with a resolution, passed by the National Grange, its Executive Committee is instructed to establish an information bureau between states, to the end that surpluses and shortages in farm commodities existing in different parts of the country may be known to would-be sellers and consumers. The information so collected is to be transmitted in some systematic form to the members of the order in the different states. If the Agricultural Department can succeed in causing transportation companies to see it in their interest to furnish cheap rates on these commodities, consumption may be greatly increased here in our own country. Herein is an opportunity to perform valuable work for our farmers, and the proper steps are being taken to that end. This will call upon state and local granges for assistance, and each should meet requirements when called upon.

There are many matters of interest regarding the proceedings of the National Grange that I would gladly convey to you but time will not permit.

PENNSYLVANIA STATE GRANGE.

Pennsylvania is the strongest in granges and grange work of any state in the Union. Its record all along the line is a monument to successful co-operation. It has successfully led a demand for a just revision of the tax laws of the state whereby many millions of dollars formerly paid by farm properties are now paid by those that escaped payment before. The Pennsylvania State Grange held a special meeting at the same time of the National meeting in order to entertain the National Grange the better. Nothing was spared that would add to our comfort and entertainment. The City of Harrisburg very complimentarily recognized our presence. Governor Hastings called and encouraged us.

INDIAN SCHOOL AND GETTYSBURG.

Public receptions and excursions to the Carlisle Indian School and to the battle field of Gettysburg were given. A description of either might consume hours. I cannot, however, pass Gettysburg without brief notice. It was here in July, 1863, that the Union and Confederate forces under command of Generals Mead and Lee, respectively, fought the same ground over and over again for three successive days. After reading about Seminary Ridge, Culp's Hill, the Peach Orchard, the Wheat Field, Cemetery Hill, Round Top, Little Round Top, Devil's Den and the Valley of Death, to go and see them seemed a revelation, for the scenes enacted, as you have them pictured in your mind, came vividly before us, and the silence of the many cannon that are standing here and there to mark the places where, during those eventful days, they sent forth their flame of death, seemed but in honor of the thousands of dead, sleeping in patriots' graves near by. The scores of monuments, standing here and there over that large tract of country, to mark the positions held by regiments and army corps at the time of certain eventful periods in the battle, are grateful tributes to heroism on the part of the several states that erected them, and at the same time they tell a touching story of the cruelties of war. At the close of this great struggle the contending forces were short about forty thousand men.

THE ORDER IN GENERAL.

The Grange throughout the United States has made substantial growth during the past year. Several of the weaker states are demonstrating that they want the Grange, and are now gaining ground rapidly. Notably, Wisconsin, Minnesota, Iowa and Kentucky. Others are doing well and show increased interest. One hundred and forty-one new and about 75 re-organized Granges have been added to the National list.

THE GRANGE UNITES FARMERS OF ALL SECTIONS.

It is worthy of mention, in the line of National Co-operation, that farmers from different parts of our broad country, representing special local interests, and belonging to different political parties, are fast laying aside prejudice and are fast progressing in that line of education which demonstrates that the great agricultural interests of our country are really one and inseparable, and that common sense demands co-operative action.

THE GRANGE IN MICHIGAN.

The Grange in Michigan, during the past year, has been progressive in all lines of its work. Eleven new and several re-organized Granges have been added. Local Grange officers have been more prompt in attendance to their official duties, and I believe meetings have been conducted along more systematic lines. These are my conclusions from the large amount of correspondence that has passed, during the year, between the Master's office and the subordinate Granges of the State.

This correspondence covers petitions to the Legislature relative to pending questions, with accompanying letters, notices at various times of special co-operative deals, with explanatory notes, special letters to all Masters, Secretaries and Lecturers, regarding their official duties, and communications to all the Granges, suggesting various beneficial matters, such as May meetings, August picnics, Grange revivals, etc.

As here expressed, constant communication has been maintained direct, between the subordinate Granges and the Master's office during the whole year. This plan has been adopted as the only sure way of reaching all the members of every Grange.

Many members, and I am sorry to say, officers, do not take the "Michigan Farmer," in which paper official communications are published. Then there is much business with subordinate Granges of such nature that publication in the Farmer would not be for the interest of the order.

From experience, I am fully convinced that the correct system to follow in communicating to Granges all matters of co-operative deals and suggestions regarding helps in Grange work, should be seasonably and often sent direct in private form to every Grange, and then, under the regular order of "Communications," read to the Grange. If the officer to whom the communication is sent does his or her duty, the whole subject matter is squarely before the Grange for consideration just at the right time.

CO-OPERATIVE TRADING.

In the matter of co-operative trading, our members have taken increased interest, as the Secretary's report of percentage received will show. This feature of Grange work is, however, yet in its infancy. If systematically perfected and executed, now that it is fairly started, it may be made of great benefit to all our members. I recommend this matter to the careful consideration of the Executive Committee.

COUNTY DEPUTY WORK.

During the year, deputy work has been made a special feature and systematically encouraged, and while the results are not as prolific in new Granges as a high degree of enthusiasm and anxiety might desire, enough has been accomplished to give encouragement for renewed effort along the same line.

While all County Deputies, no doubt, desire to see Grange lines extended, many of them are so situated that they cannot or do not give the necessary time to thoroughly prepare and execute the work on a scale justified by the vast unoccupied territory in each of their respective counties. The successful organizer need not be an eloquent speaker, but instead, should possess the genius and push of a successful agent, and the tenacity of purpose which knows no fail. With these, all obstacles will be overcome, and success result from their efforts. Be not discouraged. "Hope and Perservere," must be the motto of every County Deputy. We often say that the harvest is ready for the reaper, but the farmers are not so anxious to organize Granges or to assist in any good work, as to cause them to come, by neighborhoods, and plead to be organized. The truth is, they are convinced that organization and co-operation are necessary to meet the requirements of the day, but they are yet to be convinced that the Grange is the ship in which to embark. This last is left for the deputy to do. Nearly every place, five miles from an existing Grange, is a suitable place for a deputy to set a stake for a center of jurisdiction, and commence his work of bringing the people together into a Grange. The question of a meeting place will take care of itself if a Grange is secured. If our fifty county deputies will thoroughly study the details of the business, and set their stakes at once, and work along such lines as their judgment will dictate in accordance with circumstances in each place, and with that determination which impels them in other lines of business, each deputy can place to his credit from 5 to 10 Granges by March first. It is apparent that since the fees were reduced it is not so easy to figure out justice to the Grange and pay the deputy an encouraging price for his effort. It now requires large charter lists. To cover this, in part, a bounty is offered to deputies in behalf of the State Grange, and to be paid out of such funds as may be set aside for lecture and field work. As a still further encouragement for deputies to visit and work for the upbuilding of the Granges they organize, I recommend that the State Grange give to said deputies one-half of the fees paid by new members for one year after the charter of the new Grange is closed. Also that the same payment be made by the State Grange to the deputy on account of all eligible applications for membership he may present to an existing Grange this to the end that the deputy will canvass the district of all existing Granges for the purpose of adding to their membership. This might also be extended and apply to all members as an encouragement to work for new members.

It is the payment of quarterly dues to the State Grange that assists its treasury most, and to get the dues, members must first be secured. It seems apparent that it will be a money making investment for the State Grange to do as recommended. If the State bounty can be maintained (which I am confident it can) and the recommended concession adopted, sufficiently encouraging compensation will be paid to deputies to encourage them to develope the art of organizing, and to give the necessary time to pushing the work.

LEGISLATIVE WORK.

Since last we met, the State Legislature has held its biennial session, and in accordance with frequent reminders that farmers constitute about one-half of the voting population of our state, and proportionately contribute to the support of all its institutions, and further in accordance with expressed desires of members of the legislature and this body, that the wishes of farmers, regarding pending questions, with suggestions, be transmitted to the legislature, that the members may the better represent their constituency, the Executive Committee of the State Grange considered and selected certain measures as being in the interests of farmers, and directed that they be presented to the legislature. Later in the session, it seemed advisable to call out the support of the Grange on other questions.

The bills, known as anti-color, to prevent appeals from Justice Courts where small amounts are involved, Traveling Library Appropriation, Farmers' Institute Appropriation, and Continuance of Tax Statistician, originated with the Grange, and were petitioned for. Of these, all were successful except the Appeals and Tax Statistician bills.

The appeals bill was championed by Representative John K. Campbell, who had large odds against him. The bill was strongly opposed in the House by our legal friends which was but natural to expect, for, if passed into law, it would deprive the bar of frequent fat fees in cases of prolonged litigation, where the litigants were guided by grit instead of judgment. The bill finally passed the House by a large majority, and was sent to the Senate, where it rests in the unreported files of the Judicial Committee. Senator Andrew Campbell worked vigorously to have it brought up for action, but could not succeed. This bill was very worthy of passage. Its provisions were such as not to deprive any citizen of attaining justice at law and was intended to save taxpayers much money annually by preventing cases, where small amounts were involved, from going to the higher courts. The bill had the indorsement of the State Association of Circuit Judges, and should have become law. It but awaits the convening of the next legislature.

The bill providing for a continuance of the investigations of the Tax Statistician was brought before the Senate by Senator Andrew Campbell. Its exact disposition by the Senate, I cannot report for want of the record. It was there buried in some form, and never appeared in the House. It was sought to continue this work, because of the intense interest the farmers and people have in the matter of an equitable and just revision and enforcement of tax laws. A statement of existing facts was considered necessary to bring about such revision and enforcement. The Tax Statistician had been at work for two years with limited assistance, collecting these statements of fact as to how the present laws operated and the manner of their enforcement, and while it was thought by some of the strongest supporters of the movement that the invesigations were not as directly aimed at existing evils as should be, it was plainly seen that the work had arrived at a point where the interest of the people demanded a continuance for a time, and under different supervision if need be. Much valuable data relative to taxation is, however, now a matter of record and will aid much in the movement for a more just collection of taxes for public expense. It was a long step backward to discontinue the investigation. The question involved will, however, continue to agitate the people until all people and all interests are subject to the same provisions and enforcement of law in the payment of general taxes.

Other measures petitioned for by the Grange and their passage urged, were the Kimmis County Salary and the Wagar State Official Salary bills. The Kimmis bill, after some amendments, passed the House by a large majority and was passed over to the Senate, and there referred to the Committee on State Affairs, and was never reported out. The provisions of this bill were based upon good business common sense. It recognized the County Board of Supervisors as the logical authority to govern county expenses, and to fix the compensation of county officers, and to so systematize and husband receipts and regulate expenditures as will not only be economically just, but at the same time will enable all to know the real receipts, and pay of county officials. That justice to taxpayers that the bill aims to establish is of the popular kind, and will come up for consideration again at no distant day.

The Wagar Salary Bill was unpopular with state officials whose salaries it sought to regulate and their influence seemed strong enough to prevent action by the Senate, in which body the bill originated. It should be remembered, however, that the farmers and a large majority of the taxpayers of the state are in favor of an adjustment of official salaries on a basis just to the employer and the employed, and in reasonable comparison with the commercial value of the service demanded.

The bills presented in the legislature to repeal the Mortgage Tax and Farm Statistics laws, and to indirectly establish the Township Unit School System in Michigan, were petitioned against by the Grange, such action being in line with the principles and past declarations of our order. We are pleased to record that the action of the legislature on all of these, with slight modifications in the Farm Statistics law, possibly for the better, was favorable to our petitions. For our success along legislative lines we should be grateful, and should not be discouraged because of our failures. The experience is of much value to our organization, and all our members who watched legislative proceedings, and will aid us in future efforts. The members of legislatures are zealous for the general interests of the state and people, and if questions can be laid before them in a way to show justice and the general good in their favor, hearty support is generally secured. But it is also true that human nature is inclined to selfishness, and this sometimes leads to strong opposition to worthy measures. Sometimes a combative spirit will control men, and then they seem to oppose without justifiable reason.

BILLS WERE LOST IN THE SENATE.

From the record it will be remembered that the Senate proved to be the executioner and undertaker in disposing of all our bills petitioned for and lost. While the measures lost had warm supporters in the Upper House, the majority opposed. Upon the whole the Grange has no complaint to offer regarding the treatment of its wishes in the last legislature, for in most cases that body concurred with our views.

FARMER MEMBERS WORKED TOGETHER.

It is well to recognize the business manner in which the farmer members of the last legislature proceeded to make their influence available and useful. Perfecting an organization, as they did, was a proper recognition of the power of counseling and acting together. To have scattered their influence would have helped others and defeated themselves. It will be best for farmer members in future legislatures to thus counsel together.

CO-OPERATION, THE BASIS.

Co-operation being the foundation principle upon which our order is built, it is incumbent upon all members to make a study of its far reaching possibilities as applied to all the aims of life and especially such as will help us financially, for upon financial success depends very largely the degree of success we may attain and enjoy socially and influentially.

To attain a reasonably high position in these as a class, is the greatest incentive to labor. Thus it is but reasonable and good common sense for farmers to employ all legislative assistance to these ends. We should not be governed by sentiment, but by business facts. The man that undertakes to make you believe that farmers are under special obligations on general principles, to certain persons and localities, preaches a doctrine by which he himself is not very likely to be influenced or governed.

The whole country is a market place and is open to the farmer, the same as to other men. The farmer is under obligations to men and localities only so far as he can reach better results in those directions. Otherwise it is not only the unquestionable privilege, but the incumbent duty of the farmer to look elsewhere and beyond. It can not be urged upon farmers too strongly, the importance of ascertaining where are located the markets in which to sell the highest and to buy the cheapest, whether it be in the local village or the distant large city; also to study and adopt such methods as will assist them in saving the greatest possible rewards from their labor. Co-operative action is the surest assistance along this line. How best to proceed is worthy of your attention and understanding. In this connection, attention is called to a book indorsed by the National Grange, entitled, "How to Co-operate." It is published by the Orange Judd Co., of Chicago, and gives detailed plans of procedure along various co-operative lines. All works on this subject should be studied and all possible information gained concerning it. It is now the question of all others for farmers to understand.

PURE FOOD.

The State Grange may look with satisfaction and pride upon the successful and beneficial operation of laws governing the manufacture and sale of food products in our state. The records will prove that the State Grange was the first to formally advocate Pure Food regulations, and to start an organized movement to have such laws enacted. The State Grange may well consider it as one of its greatest achievements. From small beginnings, both in appropriation and legal requirements, more perfect regulations are being enacted and enforced with the indorsement and willing co-operation of all consumers and fair-minded dealers. The principles involved in the enforcement of Pure Food laws appeal to the moral and justice loving sensibilities of people to such an extent that they will demand such additions to present laws as to completely eradicate fraud and deception from the manufacture and sale of food products, so that the purchasers and consumers will be protected in receiving that which is desired, asked and paid for. This protection to purchasers should to extended to drugs, clothing and dry goods, and to all articles of merchandise in the manufacture and sale of which fraud and deception are so frequently practiced.

Believing that it is proper to recognize good service from public officials, we may mention that in putting into successful operation without serious friction regulations that required such radical changes in the methods and stocks of manufacturers and dealers, the thanks of the people are due ex-Commissioner Storrs for his firmness, fairness and wisdom in the matter; also to present Commissioner Grosvenor, for the vigorous and thorough methods now employed in prosecutions and inspections necessary to enforce and teach people the full requirements of the law. All people who believe in eliminating fraud and deception from the manufacture and sale of food products should vigorously support Commissioner Grosvenor in his present suit to maintain the anti-color law.

TOWN CONVENIENCES EXTENDED TO THE FARM.

It is the exalted mission of the Grange to teach farm people to love the country and their homes therein, not only because of the financial interests they may have in its occupations and as a mere abiding place, but because of its grandeur, freedom and purity; its fresh air and glittering fields of dew, and its abounding evidences of divine wisdom, all of which should cause the heart to swell with adoration, gratitude and love; for of such it is to truly love the country.

Because of these and having our fixed abode in company with them, we will teach every farmer to surround his home with all of the comforts, conveniences and helpful agencies the world can give. Through the Grange meetings we contribute to our social and educational wants by coming together from different neighborhoods in fraternity, for readings, recitations, discussions and friendly counsel. The Grange advocates bringing to the people in the country every possible benefit enjoyed by town and city people, believing that in no other way can we satisfy the prsent demands of home.

FREE RURAL MAIL DELIVERY.

Along this line, the Grange was found among the first to advocate "Free Rural Mail Delivery." At sessions of the National and State Granges for several years back, resolutions favoring the adoption of this system have been adopted. We are now pleased to note that the constant dropping is wearing away the rock, and objections and doubts, and public opinion is fast crystalizing in favor of the system. Experimental appropriations have been made and work performed with results proving that the general adoption of the plan is feasible and desirable. In accordance with these results, it is published that the present postmaster general declares in favor of the general system of Free Rural Mail Delivery, at the earliest possible time. We should continue our requests, however, until our wishes are fully realized, so that the farmer, on his return from the fields, will find his letters and daily paper awaiting him, and his outgoing mail far on its way to destination.

NO HAWKERS AND PEDDLERS LICENSE IN THE COUNTRY.

In connection with the work of encouraging and securing all possible conveniences to country people, special attention is here called to an existing law, certain portions of which are strongely antagonistic to the best interests and desires of country people, and should be repealed. Reference is made to the law regulating and licensing the hawking and peddling of goods in rural districts, and which demands the payment of a license by local store keepers and others for the privileges of carrying groceries and other wares in horse wagons to farmers' houses and there sold or exchanged for butter and eggs as the case may be. The license is so high as to be prohibitive and is wholly wrong. It is in the interest of stores in the larger towns, and is calculated to force farmers to go to the towns to transact this business. We repeat that there should be no barriers in the way of all these conveniences coming to us in the country, and it is the duty we owe our homes to use our strongest influence against such obstructions to our natural rights. It is a great saving of time during the busy seasons of the year to have the small necessities brought to the farmers' door, and in the older parts of the state, where farmers have had these conveniences, the business has proven satisfactory, both as to prices and quality of goods. The farmers enjoy going to town, and will go when they desire, but a law which operates to compel them to go when it is to their profit to cultivate and harvest crops, is too ancient for this progressive age, and should be repealed. The attention of this body is called to the matter with the view of possible action to the end that the next legislature may be memorialized asking repeal of this trespass upon the natural rights of farm people.

FARMERS MUST BE SELF-RELIANT.

In support of work along the line of farmers helping themselves, I wish to emphasize the ideas already suggested. I would have the farmer consider himself and so prepare himself that he is the peer of any man, and to so broaden his ideas that he will assert his independence of old-fashioned notions that bind him here, and obligate him there.

Throw mere sentiment to the winds and in the strength and freedom of full manhood, look out over the world of benefits and opportunities and say, "These are for me, the same as for other men. My country home is my palace, and there I live from choice, and from there will I reach out to near and far and I will labor to bring all attainable benefits, and place them close to my door." Such ideas should govern the acts of every farmer in the land. If such can be, what is there that the farmer cannot have? He would not then act hesitatingly, as if asking, "Please, sir, may I do this?" but instead, he would act with confidence and that which he willed, in the line of justice and reason, would be his.

FARMERS INSTITUTES ETC.

Granges and members in all parts of the state should take a deep interest in the success of Farmers' Institutes. Attendance and participation in proceedings should be the rule. Institute and Grange work are of the same and each will benefit the other.

The Farm Home Reading Circle should not be neglected. Its utility in the work of disseminating useful knowledge in unquestioned.

Granges should not neglect to provide members with books through the Traveling Library system. The State Librarian will furnish all needed information on application.

Farmers' Institutes, Home Reading Circles and Traveling Libraries are all children of the Grange, and as such should receive parental care and support from all our members.

AGRICULTURAL COLLEGE.

The farmers' school, the State Agricultural College, is growing in practical usefulness each year. New lines of work are being taken up in accordance with the changes that take place in our agricultural operations, and the advanced ideas of our farm people. Co-education, the establishment of which, at the college, was accomplished through Grange agitation and influence, is a success. Instruction in butter making and the recent establishment of a short course in cheese making, with the assistance of scientific appliances, are in answer to the demands of the increased dairy interests of the state. There is already a demand for butter and cheese makers, skilled in the use of recently invented scientific utensils, and holding diplomas from these dairy schools.

The plan adopted by the college, whereby the results of all experiments are seasonably sent out to all farmers upon application in bulletin form, is commendable as being the most practical method for thorough and direct dissemination of these findings. Every Grange in the state should receive regular supplies for distribution among members. It is plain to see that the college is growing in favor among farmers. This will doubtless result in increased attendance and greater usefulness.

ELECT U. S. SENATORS BY DIRECT VOTE.

Our demands for the election of United States senators by direct vote of the people should be continued without discouragement. Final success in work for other reforms proves that in time the people will succeed in having this healthy reform adopted. The questions of justice and clean government are back of this movement. To realize that men are nominated or defeated in primary caucuses and nominating conventions that lead to the state legislature, at the dictation of a candidate for the United Statees Senate, entirely disregarding State legislation and fitness of men, is too near one-man power to be long tolerated by the American people. In a country like ours, where the voice of the people is the power supreme, we may rest assured that this change will come.

POSTAL SAVINGS BANKS.

Among the reforms now being advocated in the interest of the mass of people, is the establishment by the government of a system of postal saving banks. Absolute safety and convenience to the people, thus encouraging thrift, and bringing large amounts of money into circulation, now hidden, because of distrust in ordinary monetary institutions, are the arguments made in its favor. Postmaster General James A. Garey advocates the system. The national Grange unanimously indorsed it. It is here presented for consideration, so that an expression thereon by the Grange may follow.

GOOD ROADS.

The question of good roads is far from settled and will continue to interest the people until some improved changes are made.

The conditions of the country roads so directly affect the results of farming that it becomes a very important question. It would be well if Granges take steps to inform their members on this coming question, to the end that they will be able to consider and act wisely in the line of their best interests, instead of complainingly looking on while others fix some new regulations upon them in accordance with some untried theory and regardless of the cost to those who must pay the bills. Our road system is faulty, now that the country is so much improved, but it should be perfected by those directly interested in the expense and business use of the roads.

RAILROAD PASSENGER RATES.

Many changes in old established methods and regulations are being made from time to time in answer to the requests of different interests and persons, and it behooves farmers to keep close watch to prevent the adoption of laws, local and state, that will give special advantages to the few at the expense of the many. In this connection, the attention of this body is called to the question of railroad passenger rates through mileage books and other special provisions. Concession through these methods are made, in the main, to the benefit of the constant traveler, and are not available or practical for the use of the occasional traveler, and who does not make repeated trips over the same territory. Mileage regulations may operate as a barrier to prevent general lower rates for the benefit of the public and may thus assist in establishing an unjust discrimination against a class of people who have contributed and sacrificed more for railroad building than all others, and who now furnish by far greater part of the business to maintain the roads in operation.

In view of a possible unfair adjustment of the question of railroad passenger fares, the earnest consideration of this body is called to consider whether or not it will be wise for the farmers of the state to unite in a memorial to the next legislature, asking the establishment of a general two cent per mile railroad passenger rate. This rate prevails over the eastern states, and it is not probable that the "Star of Empire" in this case will move on to the west very rapidly unless our people act to accelerate its movement.

THE FARMERS' DUTY.

In calling your attention to some of the foregoing questions, I desire to add that it is the order of the day for the different interests and people to seek special advantages, ofttimes not inquiring whose welfare is imperiled thereby. The wonderful opportunities offered ambitious men by the swift development of our great country have brought on this friendly contest for special advantages, and if farmers desire and expect to secure and maintain just privileges and rights, they must arise to the situation and be alert and doing.

They have the power and the machinery of organization through which to act. If they falter and rest in quiet composure no complaint should be made of that which follows.

AGRICULTURAL AND GRANGE PRESS.

The usefulness and power of the press in advocacy of any given principle or work are well known to all. The grange that fails to, in some way, encourage the presence of grange reading in every family of its membership is not living up to its full duties.

The Michigan Farmer now contains a two page Grange Department conducted by Bro. K. L. Butterfield in a thoughtful and earnest manner. The department is yours to contribute to, to improve and to perfect. Through this medium every member of our organization may keep informed in grange work, and at the same time have before him most valuable reading on all agricultural topics. Every grange should commence the new year with club lists for this valuable paper.

In this connection it is but just to recognize the friendly spirit and valuable service rendered by the Michigan Fruit Grower and Practical Farmer, published at Grand Rapids, in conducting a very readable Grange Department under the care of Bro. Melvin S. Smith of Talmadge. We hope for it success and a liberal patronage.

NO BREAKS IN THE RANKS.

It has not been reported to the Master's office that any member prominently connected with the work of the State Grange has passed this life since last we met. That a kind Providence has so guarded their lives is cause for prayers of gratitude. To mourning members, if such there be, among the Subordinate Granges of the state, we extend a fraternal sympathy.

THE EARLY WORKERS.

In looking over the achievements, present work and future possibilities of this grand organization, our thoughts naturally turn to those who braved the battles at the beginning. Many of that noble band of men and women have passed from earth forever. Some of them still remain with us to counsel and cheer us on in the work. Long may their lives be spared and may the work and progress of the order be such as to comfort them in their declining years.

AGRICULTURE.

To present a general address to the State Grange, and be silent on the great question of agriculture, would seem to be an evasion of duty. Because of the needs of this foundation interest, and the people who work and live as a part of it. the organization that you represent on this floor was called into being.

It is a favorable omen that our country is awaking more and more to the importance of agriculture prosperity. But a few years since, all other interests were considered first and at length, while that of agriculture was fortunate to receive notice by title only. This was doubtless the result of indifference on the part of the farmers of the country. That agriculture now receives earnest consideration is no doubt because of organized effort, and foremost in this work has been, and now is, the order of Patrons of Husbandry.

Agriculture is just now in an embryo condition. The partial change in government policy has not developed sufficiently to know its full effects in operation with the constantly changing conditions in our own and other countries. We should, however, hope for the best and should encourage hope always. During several years past, we have witnessed a general decline in agricultural investments until a condition was reached that made the stoutest hearts waver. Economic physicians widely, and no doubt honestly, differ as to the cause. We cannot reasonably say that the one is wholly right and the other wholly wrong, for all are citizens of our common country, and no doubt wish for its full success.

In the discussion of all great questions extremists are liable to trespass upon untenable ground, while the real truth is most likely to be found half way between the contending parties. This is probably true in the solution of the present agricultural problem. As farmers we should therefore exercise charity and forbearance with all our brother farmers and others who honestly differ with us. I need not tell you that this is in direct line with the teachings of the grange, for so it is.

It is fair to say that a generally better feeling exists among farmers than when last we met, because of better prices for a part of their staple products. As to the cause of the higher prices for some commodities and lower for others. I will leave for partisans to settle. The probable truth. however, is that the inexorable law of supply and demand influenced by tariff on imports, in some cases, and unavoidable foreign competition, in other cases, cover the main causes.

Farmers are awaiting patiently and expectantly. The pessimist and the optimist are still in the land, and each are misleading in their influence, while neither can change existing conditions. Of the two, the optimist may do the most harm, by encouraging extravagance and fictitious booms, which are liable to collapse with disastrous results. Let all be of good cheer, study well your diversification of crops, read liberally, and think closely, and work with fellow farmers for the general good of your calling, and in due time, we will be rewarded with that love and attachment of our occupation which comes only from satisfactory profits.

CONCLUSION.

In conclusion, I cannot urge you too strongly to take up the work of the session with earnestness, and let your aim be to do that which will strengthen the order througout the state. You are honored with seats in this body to devise ways and means to this end. May the thousands of Patrons, all over our state, refer to this session of the State Grange with satisfaction, because of the good done.

GEO. B. HORTON.

Hon. J. H. Brigham, Assistant Secretary of Agriculture, was present and addressed the grange, his chief topic being the work of the National department of agriculture. He credited the grange with first urging the establishment of the department of agriculture. The chief items of the department's work which he mentioned were: A more systematic system of crop reporting; the gathering of information which will lead to the manufacture of our own beet sugar in this country; the stamping out of animal diseases; the extension of the world's markets for our agricultural products; and the suppression of counterfeit products of all sorts.

Judge Ramsdell offered a resolution commending the Department of Agriculture for its work.

E. B. Ward, overseer, reported strong and active work in the grange and recommended that the county deputy system be pushed vigorously by men of special training.

Lady Assistant Steward Robertson made a vigorous plea for more equal property rights for women. The M. A. C. brass band furnished the music and the grange voted to visit the college Wednesday afternoon.

Miss Jennie Buell, the secretary, reported the total receipts for the year at $4,039.39, a gain over last year of $397.22; and disbursements $3,911.54, or $74.91 less than last year. Twelve new granges were organized and seven reorganized during the year.

Wednesday morning Miss Edith F. McDermott spoke of the department of domestic science at the Agricultural College, and Mrs. J. L. K. Haner spoke of the work in the sewing room.

Jason Woodman, lecturer, reported three months work in the field during the year. He urged the necessity of putting the work and objects of the grange before the farmers. He urged the enforcement of the oleo law.

Sister Knight Ceres, in her report, dwelt upon the beauty of home life, especially the importance of the husband and wife working together.

Miss Estella Buell, Pomona, spoke of the influence of fruit culture in the development of character. Assistant Steward Robinson reported the benefits of education and co-operation; in Newaygo county they have a purchasing agent for the granges, and are carrying out in a practical and successful manner the principles of the grange in the matter of co-operation.

The treasurer submitted his report, which was practically a recapitulation of the financial part of the secretary's report. Mrs. Mary A. Mayo, the chaplain, in her report dwelt upon the necessity of moral and religious instruction in our public schools.

Wednesday afternoon was spent in visiting the Agricultural College, and all seemed pleased with the condition of affairs.

Wednesday evening a union meeting was held with the State Association of Farmers' Clubs. President Daniels of the farmers' clubs presided and delivered an address of welcome. Master Horton of the State Grange gave the response. Gov. Pingree was introduced and spoke on the reduction of railroad fares, the danger of the concentration of wealth, equal taxation and other topics. His remarks were well received.

Ex-president Kimmis of the farmers' clubs gave a scholarly and thoughtful address on effective work with the legislature.

Mrs. Mayo submitted a report of the committee on woman's work in the grange. During the year two lines of work were taken up, one the fresh air work, the other the visits to schools; 202 young people enjoyed the two weeks' outing. The people who have entertained these city visitors are those of limited means. Mrs. Mary C. Spencer, State Librarian, spoke of the traveling library. There are now out 140 libraries of 50 volumes each.

The following were elected members of the executive committee, being re-elections: F. W. Redfern, of Clinton county, E. A. Holden, of Ingham, R. K. Devine, of Oakland.

Thursday afternoon was given up to the consideration of subordinate grange work. Thursday evening the fifth degree was conferred on a class of 30, and the sixth degree on a class of 57. The committee on dormant granges reported with recommendations calculated to revivify them.

Judge Ramsdell of the committee on taxation reported as follows:

Resolved, That we favor the equal and just taxation of corporate property, and especially that class of corporate property, owned, controlled and operated by corporations receiving their right to do business through valuable franchises granted by the state.

Resolved, That we pledge our hearty support to all reasonable efforts made or to be made by the present state administration, or any future administration, to right the wrongs that are being suffered by the farming and business interests of the state, on account of the unequal taxation of this class of corporate property.

Resolved, That we direct the members of the legislative committee of this body, who may represent us at any general or special session of the legislature, to present the views of this body, upon the subject of such taxation, and to aid as far as possible in bringing about a reasonable and adequate reform in that behalf.

Resolved, That we will not knowingly support, either in nominating conventions or at the polls, any person for either the House of Representatives or the State Senate, who is not earnestly in favor of compelling corporate property to bear its just and proper proportion of the burdens of taxation.

The resolutions were adopted.

D. F. Holden reported for the committee on Transportation recommending a flat two cent passenger fare on Michigan railroads, also a stable and uniform freight rate, expressing the idea that the State Legislature should supervise freight rates.

N. I. Moore reported for the committee on Co-operation, mentioning the success of the trade arrangements. Master Horton stated that he expected to make 30 contracts in grange trade arrangements in his subordinate grange.

The per diem and expenses of the officers was reduced so as to correspond with that of the delegates. Peter Voorheis of the committee on legislative action, reported in favor of the pure food laws now on the statute books and their rigid enforcement, favoring the repeal of the law licensing hawkers and peddlers, against a resolution for enabling two-thirds of three-quarters of a jury to convict in certain cases; favoring the equal property rights of women; against any immediate agitation for a tax statistician; in favor of repealing the law preventing the killing of squirrels in certain seasons; in favor of leaving the expenditures for country roads about as they now are; in favor of a reform in the methods of printing state documents; also endorsing the legislative part of the master's address.

The report of the committee on woman's work made a strong plea for woman suffrage, equal property rights for women and commending the fresh air work.

The committee on education reported in favor of the uniformity of text-books and in opposition to the township unit system.

The committee on the Agricultural College reported, commending the present condition of the institution and urged the Patrons to support the college by sending their children there.

The committee on resolutions, recommended that the Patrons uniform themselves during the coming year on the subject of postal savings banks; urged the discontinuance of the present costly system of distribution of seeds from Washington; renewed agitation of the question of election of United States Senators by popular vote; also free rural mail delivery.

The committee on agriculture reported against the practice of gambling in futures on boards of trade, and against the adulteration of seeds, farmers were urged to send samples of seeds to the experiment station at the Agricultural College for examination before buying large quantities.

Mr. Jacokes of Eaton county, made a special report, urging more music in the grange.

Friday evening was devoted to a "love-feast," at which the Patrons congratulated themselves on the prosperity of their organization.

Geo. B. Horton was elected Master, and Jennie Buell Secretary.

STATE ASSOCIATION OF FARMERS' CLUBS.

The opening session of the fifth annual meeting of the Michigan State Association of Farmers' Clubs was held in the Senate Chamber of the Capitol. Tuesday evening, December 14, 1897. One hundred and fifty delegates representing one hundred clubs were in attendance.

The address of welcome was delivered by Judge Joseph B. Moore of the supreme court, who said in part:

"It gives me great pleasure to greet the representatives of 100 farmers' clubs, with a membership of 5,000 people who have met in the interest of the 150,000 farmers of the state, who with their families comprise three-quarters of a million of people, and to extend to you a most cordial and hearty welcome to the capital of this great state. I have the more pleasure in doing this because my father and three brothers are farmers, and in my boyhood days I lived upon a farm, and know about the troubles as well as the compensations of farm life. Though so recent arrival at Lansing, I can say to you with confidence that with its broad avenues, lined with trees, its fine churches and its public buildings and its many homes, it is a beautiful city. The citizens, too, are an intelligent and hospitable people."

The judge pointed out the various places of interest and urged the visitors to inspect them all and make themselves known and at home. He then gave an interesting account of the work of the supreme court and expressed the hope that the meeting would be both interesting and profitable.

Col. I. H. Ives of the Ingham County Club responded and congratulated his associates upon the improvement in the times from one year ago, saying that the faces of the farmers are certainly rounder and their spirits are better.

Pres. Daniells appointed standing committees as follows: General Resolutions, Hon. A. N. Kimmis, D. H. Speer, John Price, J. W. Hilton and W. C. Flummerfelt. National Affairs, F. W. Munson, Brad L. Hubert, Josiah Emery, Jay Sessions and L. D. Bromley. Club Extension, Hon. A. L. Beemis, T. B. Halladay, M. W. West and M. K. Preston. Constitution and By-Laws, H. P. Keys, Edwin Ball and P. J. Jennings. Credentials, E. L. Lockwood, J. T. Chambers, E. Foster and W. L .Herman. Auditing, J. W. Swigart and A. B. Cook.

Secretary F. D. Wells then presented his report of the last meeting, which showed that the size of the clubs vary from a membership of 20 to 200; the average may safely be placed at 60. He could not state the exact number of clubs in the state, as many of them wait until this the annual meeting, before joining, but 100 would be a safe estimate, and according to that more than 6,000 Michigan farmers are active members of the state association.

A recess of ten minutes was taken to allow delegates to pay annual dues.

Short verbal reports from fifty-three clubs were made, of the condition of club work throughout the state.

TUESDAY EVENING.

President Daniells delivered his annual address as follows:

ADDRESS OF PRESIDENT J. T. DANIELLS, BEFORE THE STATE ASSOCIATION.

Another year of associational work has passed, and again we meet in an annual convention, to review the work—now of the past—and to plan for the duties and the labors of the future.

I can not forbear to refer—even at the risk of repeating that which has been stated in former annual addresses before the association—to the fact, undisputed and undisputable, of the unprecedented growth of our State Association, in strength, in usefulness and in public regard. It stands the test of that true measure of its worth—practical results attained.

When delegates from twenty-two Farmers' Clubs met in this room on February 1, 1894, to determine the feasibility and the advisability of organizing a State Association, sincere and earnest friends of club work felt serious misgivings lest the results should fail to justify the idea. Less than four years have passed and the number of local clubs has been multiplied by six, while the association welcomes to its annual meeting delegates from all parts of the state, and in numbers quadrupled; and thus does the present give answer to the question of four years since, "Is it wise to form a State Association of the Farmers' Clubs of Michigan?" And this is but one feature of the good work already accomplished. Well may every club worker throughout the state in view of these facts "rejoice and be glad."

It is not necessary to elucidate the fact that there are ever some changes in the conditions that surround us, which though most desirable to have made—yet can they be made only through the medium and by the powers of united efforts. This fact is exemplified all through human affairs, and needs no further proof. Again: This is a day of organization—this is a generation which seeks to accomplish by the uniting of individual forces and agencies—and those of other callings having now each their own distinctive organization, fully necessitates a more complete and thorough organization of that class, which though the most numerous and the most essential, yet are its members necessarily the most isolated—the farmer class. These and other facts are ample justification for our present efforts along these lines, were justification called for.

The Michigan State Association of Farmers' Clubs exists because it has a work to do. Its formation was opportune and its growth has been marvelous, while its work thus far accomplished has never shamed its friends. As the pioneer in its lines and methods it has opened the way and led the van guard, causing others to follow, and today similar State Associations of Farmers' Clubs are formed and doing good work in many of our sister states, while inquiries, looking to similar organizations—have been received by Secretary Wells from as far south as Georgia and from the west as far as Colorado. This is the leaven spreading and a National organization may not be far distant. In consideration of the fact that this organization is "The Pioneer" in its distinctive methods and work, it should be exempt—in large measure—from criticism or censure, if it has made mistakes. But those best acquainted in its work see in it little cause for regret or complaint.

To those tried and faithful friends of the association who have labored so wisely, so well and so persistently for the advancement of its best interests, I desire to express on behalf of the association, its most sincere gratitude. It is through your efforts and by your labors in its behalf, that the association stands today on the high and vantage ground to which it has already attained, while before it open broad fields with bright prospects. The work developing upon the association's secretary has increased from year to year. The report submitted by Secretary Wells shows the extent and scope of the work of the year now closing. Let the conscientious faithfulness with which these duties have been performed, though thoroughly burdensome at times, merit the warmest approval of this association.

The organization well illustrates the working of a pure democracy in that it is composed of delegates directly and perhaps more fully amenable as representatives, than is found in any other organization, and herein may be found one principal source of its strength. Surely no one will question the statement that the nearer power is kept to its source—the people—the safer it is and the more surely will the people be well served. This State Association is but the medium through which is given expression to the will of the local clubs.

Again: The officers of this association are rewarded for their services as such not with "filthy lucre," which is so apt to tarnish the motives prompting to action, but instead, their reward comes in that which is of true worth—the satisfying consciousness of good work well done. And it may not be inappropriate to suggest in this connection that better services would be rendered to the people of this republic, were all public offices filled by men who were invited thereto not by the consideration of financial gain, not by that of personal preferment, but instead by the more honorable and only safe motive, thus satisfying consciousness of a public trust faithfully discharged.

Since our last annual meeting the association has made its first attempt to influence legislation, and in favor of those measures which it advocates, and as expressed in its "Declaration of Principles" adopted one year since.

The results of those efforts with the legislature, while not all that could have been wished for, yet do they amply justify the belief that the State Association of Farmers' Clubs does wield, and that it is destined to continue to wield a powerful and a most beneficial influence upon legislation, and that the immediate future will show by results. this to be true. But to most surely and fully accomplish this it is essential that every local club unite and work with the State Association and that it shall show in the future as it has shown in the past sufficient radicalism to be progressive, while possessing sufficient conservatism to be just.

While a careful review of the past, discovering both its success and its failures—if there have been any failures—with the immediate cause or causes therefor, is often one of the best means by which to make suitable preparations for the future; yet it is not well to linger in the past, though pleasant its memories may be, for while retrospection may afford us this of real value, yet life and living are of the present which demands our first attention, and our faces should be turned ever toward the future with its labors which wait our doing. But before inviting your attention to the lines of work which it may be deemed best to take up in the immediate future, I desire to refer briefly to the great unanimity and promptness with which the local clubs from all portions of the state responded to the request of the association to forward petitions to the legislature asking for the favorable consideration of those measures by the legislature which were introduced and advocated at the instance of the Association of Farmers' Clubs. It has been said, reiterated and insisted upon as being true, that the farmers will not unite—that they cannot be united—but abundant proof is at hand to show that the farmers isolated in scattered homes though they be, yet when important measures affecting their interests and the best interests of the people, are at stake and in jeopardy, the farmers can be united and can bring their united force to bear for the accomplishment of the object sought. And hereafter let none regard the agriculturist as unable to care for his own interests and for those interests entrusted to his care. The farmer of this day, unlike his predecessors of a few generations past, is taking his proper place in affairs, and this place is well to the front. No longer does he humbly say as said the reprimanded soldier of the first Napoleon: "It is yours to command and mine to obey," but instead he has become properly self asserting, and this is as it should be. The bread producer is the prime factor and cannot be ignored if correct results are to be reached, but do not understand me as advocating "classism" for it is with a feeling of commendable pride that attention is called to the fact that the State Association has not descended and I trust that it never will descend to the plane of advocating "class legislation." Just measures must not be deemed "class measures."

I cannot forbear the calling of your attention to the fact that one of the most forceful and essential agencies for the accomplishment of all this in which we so justly and truly rejoice, is the Farmers' Club Department in The Michigan Farmer. To the proprietors of that ably conducted and widely circulated publication, through whose generosity the association has become possessed of the essential benefits of an official organ, so vitally necessary for the accomplishment of its purposes, the gratitude of this association is due. In this department has been gathered from week to week, the consensus of opinions held by the local clubs upon those principles and measures of which it was essential to know, thereby enabling the work to be conducted, under the editorial management of ex-President A. C. Bird, that I desire to call your special attention. For his earnest, continuous and most helpful efforts, here and elsewhere, for the promotion of the best interests of the work, our deep gratitude is due.

A careful review of the work of the past year, with its rich results already ours, gives inspiration for the future and for future efforts. You are now to take under advisement the various interests of the association and are to determine what shall be the work and by what means and methods it shall be prosecuted during the coming year.

The association question submitted by the committee for the consideration of the clubs at the October meeting very properly sought to obtain opportune expression from each club as to the work which it deemed most essential and profitable for the association to take up or to continue for the next twelve months. So far as the local clubs have given expression to their views, there appears to be a very great unanimity of opinion as to what the work should be, and that the organization of new clubs, with the increasing efficiency of those already formed, should most properly claim first attention. If this shall be your conclusion, the number of clubs may be nearly doubled within the next year and the 1,000 mark reached ere the recurrence of many annual meetings. There should be one club at least in each township, while some townships can well support two clubs. This will call for earnest work. It also means to every laborer in the cause a rich reward for good work accomplished. The 300 Farmers' Clubs already in the work with a membership of 20,000 of the progressive men and women of the state, are bringing into those 300 communities and into those thousands of homes benefits and blessings not easily computed. The grounds which the Farmers' Clubs are working is a field distinctively their own, and with methods peculiarly theirs, while the glorious results of their work reach far and wide.

It will not be forgotten in your deliberations that ere our next annual meeting shall occur the Representatives and Senators which compose the legislature of 1899 will have been elected and it will doubtless be deemed both wise and essential to reaffirm the resolutions bearing upon this subject which were adopted by this association two years since. These resolutions may be epitomized as requiring of every candidate for public office and especially for a legislative office, a pledge that in the event of their election they will faithfully work for the spirit of the reforms which this association advocated. At this time should preliminary work be done and the necessary steps be taken looking to effective work with the legislature of 1899. Let nothing be left undone from now on which may be essential to the securing from the next legislature that considerate and well-advised action upon which the principles and measures which this association advocates which shall result in their incorporation into the laws of the State. Through wise, earnest and persistent effort only on the part of the association will this be accomplished, but the object sought demands and justifies best efforts.

Among the important duties devolving upon this convention is that of the selecting of those into whose hands are to be placed, to a very large extent, the many interests of the association during the coming year. In consideration of the large discretionary powers which under its somewhat distinctive organization is placed in the hands of the associational officers, it is of great moment that in the selecting of those officers wise considerations alone shall guide.

As with each preceding annual convention—so will it be with this one—people will carefully scrutinize its every act and critically review every measure which it shall adopt. Your acts and your conclusions must stand the judgment of public option. Let them be such that they will not suffer when tried before the bar of this, the final court. It has heretofore been fully demonstrated that this association is composed of delegates sufficiently broad in their views and sufficiently charitable in their sentiments, to permit with safety the full examination of every question which should come before it for consideration. Let its good name and fair name be fully maintained and let those courtesies and that forbearance which have heretofore prevailed, abide with us at this time. If it shall seem that work for the coming year has not been outlined herein with sufficient definiteness and clearness, let it be remembered that the association has now the experience of past years to aid it and scarcely needs other assistance.

As your presiding officer, I shall to the best of my ability, endeavor faithfully to discharge the duties devolving upon me. I ask for your charitable judgment if errors occur, and ask for and expect your earnest co-operation with me, to the end that the earnest and calm deliberations of the delegates here assembled, over every important question which shall come before you for adjustment, right conclusions only may be reached, and that the work here done shall establish beyond question the ability and integrity of this convention.

The boys of the Industrial School presented a gavel to the President.

Assistant Secretary of Agriculture, Col. J. H. Brigham, addressed the association. He spoke in part as follows: "My proudest thought is that I have devoted a large portion of my life to the organization of farmers. Individually, farmers are weak. Organized, they can accomplish almost everything they may undertake. The fraternal relations existing between the Farmers' Club and Grange in this State portends great prosperity for both. Agriculture is the most important of all industries. There is not enough of both gold and silver mined annually in the United States to pay for one-half the annual egg product of the American hen. Not enough is mined in the whole world to pay for the wheat or corn product of this country for a single year. Other interests may be destroyed, but agriculture must remain. When agriculture goes all else goes with it. When times are hard and business depressed, the first gleam comes with returning prosperity to the farmer. Farmers should not antagonize other interests. Neither should other interests fail to respect farmers. I have no sympathy and no patience with the man who attempts to array class against class. Farmers are not fairly represented in legislative affairs. They should demand recognition in the distribution of honors. How else can we expect to keep ambitious boys upon the farm? We pay more than our share of taxes. This should not be. We are willing to pay our share but no more. How can we obtain these things—a fair share in the profits of our business, a recognition in the distribution of honors, and equalized taxation? One word answers these questions—organize. Association is the secret. We must solve this problem for ourselves. No one will help us. We alone are to blame if we do not succeed. The responsibility is our own. Even the great money power and the great corporations cannot cope with the united power of the American farmers.

The agricultural department at Washington should be kept in charge of men whose sympathies are along agricultural lines. The department is at present trying to do the following things: 1. To perfect the system of crop reports. 2. To perfect the weather reports. 3. To secure a greater diversification of crops. 4. To stop adulterations. We expect to succeed.

The President's address was discussed by Clyde and Grant Farmers' Clubs.

"The Farmers' Club, Why?" a paper by Mrs. E. L. Lockwood, was discussed by North Plains and Vassar Clubs.

The music for the session was furnished by students from M. A. C.

WEDNESDAY MORNING.

Mrs. J. L. K. Haner, instructor in sewing at the Agricultural College, talked on the Women's Course at M. A. C.

Prof. Edith McDermott, who is at the head of the Women's Department at the college, was called upon and talked most enthusiastically of her work for fifteen minutes.

President Snyder of the college followed, laying special emphasis on the fact that the college seeks to train young women to be home-makers, not to fit them to cope with men in professional life.

Mr. Pratt of the Linden Club and Mr. Lockwood of the Summerfield and Deerfield Club, took this occasion to pay special tribute to the women of our organization. Many of the lady delegates took part in this discussion and Prof. McDermott had the exceeding great pleasure of listening to unqualified words of praise from every speaker with reference to the work of her department at the college.

A paper prepared by the Rev. John Russell on "The Social Influence of Farmers' Clubs," was read by A. B. Cook.

In the afternoon the association visited the Agricultural College.

In the evening a joint session was held with the State Grange.

THURSDAY MORNING.

The election of officers for the ensuing year resulted as follows: President, E. J. Cook, Owosso; Vice President, Mrs. E. L. Lockwood, Petersburg; secretary and treasurer, E. M. Pierce, Elva; directors for three years, H. Gaunt, Highland; A. P. Greene, Eaton Rapids.

A committee of three was named by Pres. Daniells to prepare associational topics for the coming year. A. C. Bird, Mrs. E. L. Lockwood and F. D. Wells, constitute this committee. Retiring President Daniells and retiring Secretary Wells were named as a committee to make arrangements with some music company for the publication of a club song book. The great interest of this session and indeed of the entire convention entered in the final consideration of committee reports.

CONSTITUTION AND BY-LAWS.

(As Amended for 1898.)

PREAMBLE.

We, the delegates from the various Farmers' Clubs of Michigan in convention assembled, realizing the importance and efficacy of organization in the promotion of ideas and the advancement of measures of general interest and benefit to the agriculturalists of this State, believing that the social, moral, intelectual and financial condition of the farmer is advanced by local organization of farmers' clubs; and that the organization of other local clubs will be promoted by a central or State association of clubs already in existence, and believing that such an organization would be a valuable means for the interchange of ideas and the securing of ends which may be deemed of general benefit to the farmers of this State, do hereby adopt the following Constitution and By-Laws for the government of such an association:

CONSTITUTION.

Article I—Name—The organiatizon shall be known as the Michigan State Association of Farmers' Clubs.

Art. II—Objects—The objects of this Association shall be as set forth in the preamble.

Art. III—Officers—The officers of this association shall be a President, Vice President, Secretary and six Directors, whose duties shall be such as usually devolve upon such officers, except that if occasion require, the Secretary shall also perform the duties of Treasurer. In case of a vacancy occurring in the office of Vice President, Secretary or Board of Directors, it shall be filled by appointment by the President.

Art. IV—The annual meeting of this association shall be held in Lansing, commencing the second Tuesday of December in each year.

Art. V—The officers of this association shall be elected at the annual meeting by ballot, a majority of all votes cast being necessary for an election. The President, Vice-President and Secretary shall be elected for one year, and one director for one year, two directors for two years, and three directors for three years, and hereafter two directors for three years shall be elected annually. No officer shall be eligible for reelection except the Secretary, who may be re-elected by a three-fourths vote of all the delegates present.

Art. VI—Any Farmers' Club, either in or without the State of Michigan, may become a member of this Association by certifying to the Secretary its desire and paying a membership fee of one dollar, which fee shall entitle said club to membership, for one club year, which shall be from the close of one annual meeting until the close of the next annual meeting.

BY-LAWS.

1. The officers of this Association shall constitute an executive committee, the duty of which shall be to prepare a program for the annual

meeting and to perform such other duties as may properly devolve upon an executive committee.

2. Each club shall be entitled to send two delegates to the meetings of the Association, who, before being seated, shall present proper credentials.

3. The officers of this Association shall assume the duties of their respective offices immediately upon the close of each annual meeting.

4. The Faculty of the Agricultural College shall be admitted to all the privileges of the floor, but shall not be entitled to vote.

5. It shall be the duty of the Secretary of the Association, upon application from any Farmers' Club for speakers or instructors on any of the subjects pertaining to the interests of such club, to designate the club, which, in his judgment, may best perform such service. The club, so designated, shall elect from their number a suitable person or persons to perform such service. The actual expense of such speaker or instructor shall be paid by the club making the application.

6. Amendments—The Constitution or By-Laws may be amended at any annual meeting of the Association. Such amendments shall require a two-thirds vote.

7. A membership fee of one dollar from each club belonging to the Association shall be paid on or before the date of the annual meeting of the Association each year. If any club fail to renew its membership as specified above, it shall be the duty of the Secretary to ascertain if such club desires to continue in the Association; if it does not, its name shall be dropped from the roll.

DECLARATION OF PRINCIPLES ADOPTED AT THE ANNUAL MEETING, 1897.

The following report of the Committee on Legislation was adopted by the Association at its annual meeting in 1897, as a Declaration of Principles:

LEGISLATIVE AFFAIRS—STATE.

1. Believing in the principle of local control of local affairs as enunciated in a bill introduced in the last legislature, known as the County Salaries Bill, Resolved, That we reaffirm our declaration that all county officials be paid in full for their respective services by stated salaries fixed by the respective Board of Supervisors, and that it be made a criminal offense for such officials to receive any fees, or other perquisites in addition to their salaries. Further, that the fees collected in the county offices be re-adjusted on an equitable basis, and that hereafter all such fees be turned into the county treasury, and become part of the general fund.

2. Resolved, That we endorse the contract system of prison labor and re-affirm that our prisoners should in the aggregate be made self-supporting.

3. Believing the question of equitable taxation to be the greatest unsolved question before the people of this State today, we re-affirm our resolution of a year ago, concerning taxation, and pledge the loyal

support of this organization in the furtherance of all legislation which shall tend to secure a more equal distribution of the burdens of taxation upon both personal property and real estate, and upon both corporate and private capital.

4. Resolved, That in civil cases no appeal should be allowed from justice courts where the amount involved is less than fifty dollars.

5. Resolved, That we approve the course of the last legislature in refusing to repeal our present system of taxing mortgages.

Following Report of Committee on National Affairs was adopted:

1. Resolved, That in view of the enormous expenditures of our National government over the receipts, we request from our senators and congressmen such legislation as will lessen appropriations consistent with good economy.

2. Resolved, That we favor a tariff properly adjusted, from which the farmer shall receive a just share of the benefits.

3. Resolved, That we observe with pleasure the growing efficiency of the Department of Agriculture, and urge upon Congress a generous treatment of the same.

4. Resolved, That we feel entire confidence in the ultimate action of our government regarding Cuba, but take this means at this time, to express our full sympathy with those who are battling for their homes and independence.

5. Resolved, That the rural free mail delivery should be extended and perfected until it covers our entire country.

6. Resolved, That we urge the rigid enforcement of our present immigration laws and ask for further legislation requiring an educational test.

7. Resolved, That we favor the establishment of postal savings banks by our national government.

8. Resolved, That we are opposed to any plan looking to the retirement of our currency known as greenbacks and treasury notes.

Following Report of Committee on General Resolutions was adopted:

1. Whereas, Hon. A. C. Bird, associate editor of the Michigan Farmer, did, in an editorial published on November 6, 1897, review and show sundry incorrect and misleading statements published in the Michigan School Moderator, under the heading "Fool Legislation and its Cause;" therefore be it

Resolved by the Michigan State Association of Farmers' Clubs, That the editorial referred to meets the approval and merits the cordial support of the Association.

2. Resolved, That we endorse the Michigan Agricultural College, commend the progressive spirit that characterizes its management, favor a better equipment of and an extension of the work of the Women's Department, and commend the Institution to the sons and daughters of the farmers of Michigan.

3. Resolved, That we appreciate the loyal support given the Association by the Michigan Farmer, and commend the efficient, earnest and fearless manner in which our department in said paper has been conducted.

Following Report of Committee on Club Extension was adopted:

1. That each existing club appoint a committee on club extension and that each member constitute himself an active committee of one for this important work.
2. That at each one-day institute there be an especial effort made to interest farmers in club work, and one or more persons appointed to meet farmers to organize new clubs, and who can furnish constitution and by-laws and take general supervision of the first meeting.
3. That programs and reports of club meetings be furnished to local papers for publication, and effort be made to interest the local press in the interests of club work and extension.
4. That there be no paid organizers in the interest of club extension.

MICHIGAN ASSOCIATION OF BREEDERS OF IMPROVED LIVE STOCK.

PROGRAM OF THE SEVENTH ANNUAL MEETING, HELD IN THE SENATE CHAMBER, AT LANSING, WEDNESDAY, DECEMBER 22, 1897.

OFFICERS FOR 1897.

President, H. H. Hinds, Stanton; Vice-President, B. F. Peckham, Albion; Secretary and Treasurer, I. H. Butterfield, Agricultural College.

Directors—John Lessiter, Cole; James N. McBride, Owosso; John C. Sharp, Jackson; H. C. Farnham, Grosse Isle; L. B. Townsend, Ionia.

9 O'CLOCK A. M.

Address of President, Hon. H. H. Hinds, of Stanton.
Report of Secretary and Treasurer.
Reference of Topics in President's Address to Special Committee.
The Development of the Dairy Cow, by Prof. C. D. Smith, of Agricultural College.
Discussion following.
The Standard Bred Horse—Discussion.
Feeding Lambs for Market, by J. H. Taft, of Mendon.
Discussion.
Election of Officers.

1:15 P. M.

Discussion of Topics presented in President's Address.
Observations on the Live Stock of Great Britain, by Prof. H. W. Mumford, of Agricultural College.
Followed by discussion.
The Bacon Hog, by N. A. Clapp, Wixom.

The Association met according to program, President Hinds in the chair.

By an oversight this was omitted from the report for 1897.

Secretary I. H Butterfield read his annual report, which consisted in a report of the proceedings of last year's meeting.

Then President Hinds made a short address, detailing the situation among live stock breeders, which had been very unsatisfactory for the past three years. He referred especially to horses, cattle and sheep. He could not see much comfort ahead for horsebreeders, but thought sheep would once more become remunerative property. He referred to the present condition of cattle in the State, and said it was nearly impossible to pick up a good grade steer of any of the improved breeds, such as were common some years ago. The extension of dairying, and crossing bulls of the dairy breeds upon cows of the beef breeds had covered the land with scrubs. The cattle of the State were really worse in quality than twenty years ago as the result of this promiscuous crossing. He predicted that those who had held fast to their improved herds and flocks would receive their reward.

Prof. H. W. Mumford of the Agricultural College followed with a paper on "Harvesting and Feeding the Corn Crop," in which he detailed the results of the various methods employed, the merits of each, and the weak points which actual practice had shown to exist. The general conclusion of the Professor seemed to be that surrounding conditions must determine the methods to be followed, as what proved best under certain circumstances would not prove so in others.

The paper was discussed by Messrs. Wm. Ball, Peter Voorhees, L. L. Harsh and others. Mr. Voorhees detailed his experience in husking and grinding, which he had found to cost him about 4 cents per bushel. Mr. Harsh spoke of the amount of fodder he had grown on a few acres, and said he felt certain he could carry six head of sheep to the acre by utilizing the corn crop, which proved to him that it exceeded in feeding value any other crop.

Prof. Manly Miles followed with a short talk, in which he took occasion to point out the great danger of too much specializing, either in practice or in the acquirement of knowledge. He pointed out the results of this in the great attention at present being given to the subject of balanced rations, as the result of the influence of the chemist upon agricultural subjects, while the more important question of the best machine, or animal, to manufacture the products into marketable commodities was ignored or forgotten. Instruction in agriculture was largaly confined to special lines, apparently with the idea of "making an agriculturist while you wait." Instruction should be more general if much was to be gained. The specialist must of necessity be narrow and circumscribed in his views.

The hour for the election of officers for the coming year having arrived, that business was taken up. Upon motion of Mr. L. L. Harsh, which was seconded, the secretary was instructed to cast the ballot of the Association for the officers elected last year, substituting the name of J. C. Sharp, of Jackson, for that of James M. Turner, of Lansing, deceased. The officers for the coming year are therefore as follows: President, H. H. Hinds, Stanton; Vice President, B. F. Peckham, Albion; Secretary and Treasurer, I. H. Butterfield, Agricultural College. Directors: John Lessiter, Pontiac; James N. McBride, Owosso; John C. Sharp, Jackson; H. C. Farnham, Grosse Isle; L. B. Townsend, Ionia.

"Sheep and Wool—the Outlook," was the next topic taken up, and it was to be opened with short papers by J. H. Taft, Mendon; Thos. Wyckoff, Orchard Lake, and Robert Gibbons, Detroit.

Mr. Taft's paper was quite short and made no reference to breeds, looking at the question wholly from its commercial aspect. He spoke strongly for the industry, and referred to the recent improvement in the outlook. He expressed great confidence in the future, and evidently intends proving his faith by his works. He has about the best flock of Hampshires in the State.

Thos. Wyckoff's paper followed and he pictured the future in roseate hues, especially for the flocks of Merino blood. It was read by the Secretary, Mr. Wyckoff not being present:

We hail with delight the hopeful future of sheep, the wealth-winning animal of Michigan and the Union. We desire to hasten the glad day when the bars shall again be laid up that were recklessly laid down to let all the cattle of the earth in to eat up the pasture that our own sheep needed. With broad charity for all, the time has come when self-preservation is the first law of life. Unsound policy is not statesmanship; class legislation is not patriotism. The right tariff, the right spirit and right methods, will again give the United States sheep and wool industry its proper position at home and abroad.

The American people have spoken with no uncertain sound. The day the incoming administration was elected every sheep of all breeds advanced in value one dollar per head in Michigan, and they are still advancing. This has added a great stimulus to our sheep business, and wealth to all the lucky owners of sheep. Sheep of pure Merino blood, both Rambouillet and American, and the Lincoln also, are selling at fabulous prices in Australia, Argentine and the Cape, and within two years I predict that select rams of both the former breeds will sell for $500 to $1,000 here in Michigan.

Our grain is needed abroad, and gold is coming here after it, which combined with rapidly increasing confidence in all business centers, sound legislation, the principle of reciprocity, administered by men who love their homes and their country above partisanship, the balance of trade will continue in our favor, and every industry will prosper.

Capital is already seeking investment, cotton is advancing, wool values are stronger, and sheep are changing hands by tens of thousands at constantly advancing prices. Men who sacrificed their flocks during the past depression, are tumbling over each other in haste to replace them before prices are advanced beyond their reach, and sad to say, hundreds of good sheep raisers have gone to the wall, or have been so crippled as to be laid by, or completely discouraged. Millions of sheep have been sacrificed in this country; drouth has done in Australia what free wool has done here. Argentine is short, while the Cape and Natal have suffered more, and now with the rinder pest added, will sweep a few millions more into oblivion before it can be eradicated. Men who can see into the future with keen eyes, know there is a safe investment in sheep and are acting accordingly; wheat, wool and cotton are all advancing, and of all these, the golden fleece presents the brightest outlook. The fine combing wool of the Rambouillet, the delaine of the American Merino, coarse wools of both varieties will soon be of the remunerative kind, and the wool grower of every breed will prosper.

I feel it is important to refer to the present discussion of a tariff on wool for revenue and protection, and the benefits resulting therefrom to the wool growers of Michigan. Every wool grower of note has felt the shrinkage on his pocketbook, caused by free wool. All parties agree that we have had experience enough by this disastrous experiment.

Under the McKinley law, we had fair protection, if we except some radical defects. The so-called Dingley bill, now before the senate, practically gives the manufacturer protection and the wool-growers none. It calls for specific duties on everything else and ad valorem for wool. This bill operates for the manufacturer only. It gives the wool-growers of Ohio, New York and Michigan less than three cents per pound protection, while New Mexico and the west get only two cents per pound and this not till August, 1898, which is of no practical value to us.

I recommend that all members of this association use their influence to have Gov. Rich, Hon. Wm. G. Markham and all congressmen and senators from their respective districts, do all in their power to prevent the passage of the Dingley bill now before the senate and to urge a call for an extra session of congress, at the earliest date possible after the 4th of March next to review our present tariff laws, restore the duty on wool, sufficient for "ample protection," and place a duty on shoddy and all adulterants of the wool trade sufficient to be practically prohibitive.

If the tariff of 1867 had been continued till this time, we would doubtless have had wool enough produced now to supply our home demand. The act of 1883 sent wool and sheep rapidly on the decline and the unsound policy of 1894 completed the ruin of this branch of agriculture. It was the most ruinous blow ever dealt by a legislative act. The present condition of the tariff is ruinous to our American sheep industry.

Sheep are now declining five millions per annum, when they ought to increase that amount. Michigan suffers her share of decrease with the rest of the country. With proper protection, sheep will increase sufficient to make mutton cheap enough to be within the reach of all, both rich and poor, for food, and at no distant day we can produce in the United States all the wool we need of all kinds, for home consumption.

Robert Gibbons followed. After speaking specially for the long wools —the Lincolns, Leicesters and Cotswolds, their origin and characteristics, their value for special locations and the necessity for their special grades of wool if requirements of manufacturers were to be met, he followed with some general remarks on sheep husbandry. We give a part of the paper:

In looking over the program for this meeting, and noting the names of those who were to speak upon the interesting topics of sheep and wool, I concluded that friend Taft would probably confine his remarks to the outlook for the Down breeds, with special reference to his particular favorites—the Hampshire—a breed worthy of his best efforts. And that Friend Wykoff, with his usual energy and enthusiasm, would speak for the Delaine Merinos, with special reference to the giants of the breed —the Rambouillet or French. It appeared to me therefore, that I would be expected to say a word for the long wool mutton breeds, or their merits and virtues would not receive due recognition from this combined meeting of Michigan's leading breeders of improved live stock.

And, in this connection, I want to refer to the great good this association has done in broadening out the breeders of the State, in making them acquainted not only with the merits of the different breeds of improved stock, but also with the good fellowship, the geniality, and sturdy good qualities of the men who are engaged in the great and patriotic work of adding to their value and making their merits known to the world. We are all standing shoulder to shoulder—the cattle breeder, the sheep breeder, the swine breeder, and the horse breeder. The old-time jealousy of breeds and classes is dying out under the kindly influence of our State Association, and a better knowledge of the various breeds gained from closer association and companionship. It is pleasant to see such good fellowship among men gathered to discuss questions which are of the greatest value to the agriculture of the State and the nation.

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Having said something for the long wools, I wish to say a little for the breeds in general. There is not one of them, and in this statement I bar none of the improved breeds, which will not repay handsomely the feed and care bestowed upon it. Its carcass is always salable at a good price, and the fleeces of the various breeds are an absolute necessity for the manufacturer. It is not therefore a question of which breed to take up, but of how to manage and care for them so as to get the greatest returns for the capital and labor invested.

I would be proud to see Michigan noted for the high quality of her flocks of all the breeds—the long, the middle, and the fine wools. I would like to see the time when breeders from other states, no matter what the breed, could find animals within our borders to improve their flocks. We have the soil, the climate, and a commanding position in the sisterhood of states which afford our breeders every advantage. All that is wanted is earnest and persevering effort, coupled with good judgment, and an honest adherence to sound business principles.

In adding to and improving your flocks you are doing a good thing for yourself, your farm, your State and the nation. An advanced and progressive sheep husbandry is a sound basis for a prosperous people. No nation, either ancient or modern, has ever become great and powerful without being the possessor of immense flocks of sheep. What would England be to-day without her flocks? And what a loss to France, Germany or Russia it would be if their flocks were suddenly wiped out of existence. Spain was once mistress of the world, and controlled a large portion of Eastern Europe and of both continents of America. At that time she had a breed of sheep so renowned and valued that the most severe penalties were enacted against any citizen who should allow a single one to be taken out of the country. When she became powerless to maintain herself her flocks declined with her, or were shipped abroad to other countries. So the Spanish Merino was spread over the world, and forms the basis of the sheep husbandry of a greater portion of the earth than any other breed.

Of all the breeds of domestic animals the sheep is the most useful to man. Its presence on the farm is a benediction. Wherever it pastures the land improves in fertility, and returns larger crops. Its fleece keeps warm the body of the tender infant, the invalid, and the aged, and enables man to withstand the fury of the elements. From its fleece come fabrics as fine and soft as down, and others so thick as to defy the fiercest storms. The rich can get nothing more luxurious than its manufactured fleece, and the poor are indebted to it for their greatest comforts. Their sheep gives up its fleece to clothe us, and dies without a murmer that we may eat and be filled. No fabric is more healthy or more grateful to our bodies than that spun from its fleece, and no animal furnishes more healthy or more nutritious food. The rich find nothing more palatable, the poor nothing cheaper or more strengthening. Every farm in the land should have its flock, and it should receive the best treatment and most abundant fare This nation will never be prosperous until it produces its own wool, and American mills run all the year on fleeces from American sheep. Abundance follows in the wake of sheep, and shuns the land that neglects them. With sheep we can eat and be clothed, and our lands increase in richness every year. For yourself, your State and your nation, I urge you to hold fast to your flocks. The sheep is one of the best gifts mankind has received from the Creator. If to-day I had to choose which of all the breeds of domestic animals I should keep, and could only have that one, I should certainly choose the sheep—and I feel confident I would make no mistake.

The discussion that followed showed a general unanimity of opinion that the sheep industry was about entering upon an era of advancement and prosperity.

When the discussion had closed, attention was called to the fact that the committee on ways and means of the House of Representatives had given notice that a tariff bill intended to be introduced into the new congress, at a special session which will probably be called in April, was in preparation, and that hearings would be accorded all interests on special days, those for agricultural products, wool and its manufactures, and live stock being set for January 5, 6 and 7. Resolutions passed by the State Merino Sheep Breeders' Association were then read, and the Association requested to take action upon them. These resolutions read as follows:

Resolved, By the Michigan Merino Sheep Breeders Association, That the ways and means committee of the National House of Representatives be earnestly requested to incorporate the schedule of duties on wools embodied in the McKinley tariff law, except that portion relating to skirted fleeces, which should be excluded in the contemplated tariff bill.

Resolved, That the schedule of duties upon wool adulterants and substitutes, included in the so-called McKinley law, be also incorporated in the proposed tariff bill, with an additional paragraph including so-called vegetable wool, or any other substitute or adulterant.

After discussion, these resolutions were indorsed without a dissenting voice, and an amendment or addition to them adopted, which reads as follows:

Resolved, By the Michigan Association of Breeders' of Improved Live Stock, That the committee on ways and means of congress be requested to incorporate in the contemplated tariff bill, the duties upon imported live stock enacted in the tariff law known as the McKinley law.

A committee having been appointed to draw and submit to the meeting a series of resolutions regarding the loss of one of its most honored members, Hon. James M. Turner, of Lansing, who has died since its last meeting, reported the following:

Whereas, since the last annual meeting of the Michigan Association of Breeders of Improved Live Stock it has pleased an all wise Providence to remove from among us one of its most esteemed and honored members; therefore

Resolved, By said Association in convention assembled, That by the death of the Honorable James M. Turner we are untimely deprived of the able counsel and energetic activity of one of our most efficient members, whose earnest and intelligent interest in advancing the live stock industry of our State has been of vast and enduring benefit to his fellow breeders; that the success achieved by him will leave such an impress upon the flocks and herds of the great State he loved so well, as will remain an enduring monument to his memory.

That, in our social and business intercourse with him, he was always so genial and courteous, so just and generous, as to make any man his admirer and friend, and that in his death we each and all feel a personal loss, and would extend to his bereaved widow and family the sincere sympathy of this Association.

Resolved further, That these resolutions be spread at large upon the records of this Association, and an engrossed copy be transmitted to Mrs. Turner.

Adopted by a rising vote.

"The Hog for the Times" was the last topic discussed, and Messrs. Warren, Rouse, McBride, Lockwood, Howe, and others all took part in the general talk. The consensus of opinion was that the hog for Michigan, under present market conditions, was one of about 200 lbs. average, which it should attain at the earliest possible moment, not too fat, but nicely finished, and representing one of the improved breeds.

While the discussion was in progress the representative of the Farmer asked the breeders present as to the prevalence of hog cholera, or swine disease, in their neighborhoods. Several reported it and in describing the symptoms the usual difference was shown, in some instances the attack beginning with a stiffness in the limbs, others with the inflammation of the eyes, mouth, and mucous membrane as if suffering from a severe cold, and in others the digestive organs showing the first symptoms of derangement. It was mentioned by several present that many farmers paid no attention to quarantining their sick hogs, and the disease was thus allowed to spread to neighboring farms. The Farmer's representative suggested that whenever the disease appeared the State Live Stock commission should be notified; and in reply to the statement that people did not like to bring on a quarrel with their neighbors by reporting, said that such matters could be reported to the commission, who would regard the communication as confidential, and make investigation. Every stock breeder and farmer should help stamp out such diseases by reporting their presence at once.

Several breeders present reported large numbers of sheep being brought into the State from the west and southwest for feeding, and that many of them were affected with scab. The counties in which this disease was reported as prevailing were Calhoun, Jackson, Eaton and Oakland. One breeder said he was afraid to ship stock at his railway station, as he knew diseased sheep had been brought in there. After some further discussion on the subject, the Association finally adjourned.

MICHIGAN ASSOCIATION OF BREEDERS OF IMPROVED LIVE STOCK.

PROGRAM OF THE EIGHTH ANNUAL MEETING HELD IN THE SENATE CHAMBER AT LANSING WEDNESDAY, DECEMBER 21, 1898.

9:00 A. M.

Address by the President.
Report of the Secretary-Treasurer.
Discussion of Topics in President's Address.

10:30 A. M.

"Wool and its Preparation for Market," by Prof. H. W. Mumford, Agricultural College.
Discussion.

11:00 A. M.

"The Situation."
Horse Breeding, Robert Gibbons.
Cattle Breeding, William Ball.
Sheep Breeding, A. A. Wood.
Swine Breeding, L. F. Conrad.
Election of Officers.

1:30 P. M.

Tuberculosis, Dr. C. E. Marshall, Bacteriologist Experiment Station, followed by Discussion of the Subject.
Some Observations Regarding Swine Plague in Michigan, Dr. G. A. Waterman, Agricultural College.

H. H. HINDS, President.
B. F. PECKHAM, Vice President.

I. H. BUTTERFIELD,
Agricultural College, Secretary.

The improved Live Stock Breeders' Association met in the Senate Chamber at Lansing, Wednesday, December 21, 1898.

The Secretary read the minutes of the last meeting, which were approved.

President Hinds presented an invitation from the Detroit Convention League and from the mayor of the city, to hold the next meeting at Detroit.

The President then delivered his annual adress. He spoke in part as follows: He called attention to an act of congress in 1816 repealing a statute passed a few years before, giving each soldier of the war of 1812 160 acres of land in Michigan. The reason given for the repeal of the law was that there was scarcely 160 acres of fit land for cultivation in the entire state. From this circumstance he argued that the development of the state has been phenomenal, and that not the smallest factor in the progress made by agriculture has been live stock industry. In 1894 it is said the census of the state showed that instead of the soil being "swampy beyond description," it was holding up 663,447 horses, 5,332 mules, 1,060,962 cattle, 1,045,151 hogs and 3,443,975 sheep, a grand total of 6,218,867 head of live stock.

While the President was unable to give figures, he was confident that the number of thoroughbred American Merino Sheep in the state is greater than in any other state in the Union and that the farmers of the state are carrying many more recorded Shropshire sheep than are owned in any other state or possibly country. The figures introduced indicated that the live stock industry in Michigan is vast, and that the members of the Association have a very satisfactory field in which to pursue their vocation.

The President referred to the contention between the breeders of recorded live stock and the raisers of breed cattle and sheep relative to their profitableness to the stock raiser, and said that the value of all live stock would be materially enchanced by the breeding from thoroughbred sires entirely. The live stock industry was said to be one requiring vigilance and learning. It is not an exact science like many of the mechanical trades, and requires the exercise of brain as well as brawn to make it a success. The general aim of the successful agricuturist in all lines of production was said to be the higest average of merits at the lowest minimum cost, thereby selling close to the top of the market with an output that has cost less than it really sells for.

The general business situation was said to have been greatly improved during the last year. Exports have increased and live stock in general has been better property than for some years. Improved and registered stock is realizing higher prices and upon the whole, the Association was said to meet under favorable circumstances. The President here threw in a few remarks concerning the late war and the acquisition of foreign territory. He said it did not require the wisdom of seer to assume that the Anglo-Saxon race is setting out on a journey that will take them around the globe at no distant day. The agriculturists were advised to line up on one side or the other of the great questions which the nation will soon have to confront. Breeders of live stock are captains of agriculture and agriculture is the foundation of our prosperity.

The President announced the death of three members and former officers of the Association—L. B. Townsend, Ionia; J. H. Taft, Mendon, and Homer A. Flint, Detroit.

The Secretary-Treasurer made financial report for the year as follows:

Balance on hand from 1897		$4 40
To Postage	$2 50	
Printing programs	2 25	
Paid Passenger Agents' Association	5 00	
Membership certificates	1 25	
Mailing same, stamped envelopes	1 20	
Additional postage	24	
Expense on Record Book to Sec'y elect	30	
Received from membership, 1898		13 50
	$12 74	$17 90
Check to Sec'y elect	5 16	
	$17 90	$17 90
Balance on hand to 1899		5 16

Prof. Mumford of the Agricultural College then presented a paper on "Wool and Its Preparation for Market," in which he described the ideal condition in which wool should be marketed; he also gave some reasons why Michigan wool does not bring the highest price in the market, the main reason being lack of care in its preparation and in being kept free from foreign bodies. The paper was quite thoroughly discussed by Mr. Peter Voorheis of Pontiac, a gentleman who has had large experience in handling wool. He defended the Michigan wool growers somewhat, from the charge of carelessness in preparing wool, and insisted that the commission merchants and manufacturers asked too much of the wool grower. He said that wool should be bought on the basis of scoured value—that is, its true value. One advantage the Ohio wool has over the Michigan wool is that in Ohio, sheep have been bred for a long time with certain ends in view, for length of staple and fine quality of wool and their fleeces are not so badly mixed as in Michigan. The manufacturers do not pay enough difference between wool that is well prepared and that which is not, to pay the grower for doing his work well. He once made an experiment in skirting wool and found that it did not pay. The manufacturers would not pay enough for the best part of the fleece to make the difference in the depreciation of the poor. He urged farmers to be careful to keep the chaff out of wool and urged that only flax or linen twine be used to tie up fleece.

The situation regarding the different classes of live stock was then discussed. Robt. Gibbons of the Michigan Farmer talked on horse breeding. He said that good draft horses promise the best return for the money and trouble in growing them. Fine carriage teams bring the highest price but require more skill in breeding and training. To sum up, only good horses will pay in the future.

Mr. William Ball talked on cattle breeding. He believes in the general purpose cattle and in continuous improvement in one line. Promiscuous crossing and grading of all breeds has done great damage to the cattle interests in Michigan.

Mr. A. A. Wood spoke of sheep breeding. It is in bad condition at present, in Michigan. He thinks breeders must come back to the old Merino sheep to produce wool and mutton, and as a foundation in crossing with other breeds.

Mr. L. F. Conrad, who was to have talked on swine, was not present. Mr. Gibbons was requested to make some remarks and said that hogs are too cheap; farmers are selling off and reducing their stock and they may bring better prices next year. The run of hogs for the last six months has been poor in quality. "I hear people talk against the corn crop for feeding hogs. I do not believe in this. Corn is the greatest crop in this country and the hog is the animal to use it. Most of the hogs that come to the market this year should have had more corn rather than less." Mr. Ball asked if the bacon hog brought a better price than others. Mr. Gibbons had not heard of any better price being paid.

Mr. E. N. Ball said he did not believe there was a farmer that knew exactly what is cost to grow a pig. He was going to try the Tamworth although they had been talked against. He did not care how the animal looked if it made him some money. Mr. J. H. Brown said that when prices are good, breeders do not weed out. Mr. E. O. Wood said he was breeding Tamworths and was ready to defend them. He was very much obliged to the other breeders for their talk against the Tamworths, as it had helped to advertise them very much.

A recess was taken to 1:30 p. m.

1:30 p. m. Association convened. On motion, the place of next meeting was fixed at Detroit.

The election of officers was then taken up. A ballot was taken for President with the following result: H. H. Hinds 16, William Ball 3, scattering 2. Mr. Hinds was declared elected.

On motion, the Secretary was instructed to cast the ballot of the Association for Peter Voorheis of Pontiac for Vice-President. The ballot was so cast and Mr. Voorheis declared elected. A ballot was taken for Secretary. Robert Gibbons having 25 votes and I. H. Butterfield 5. Mr. Gibbons was declared elected. The following directors were elected for the ensuing year: Messrs. John Lessiter, Pontiac; M. R. Freeman, Flushing; W. E. Boyden, Delhi Mills; John McKay, Romeo, and L. F. Conrad, Waconsta.

The President was requested to appoint a committee of three to present suitable resolutions in memory of deceased members. The President appointed Messrs. Butterfield, Boyden and D. P. Dewey.

Dr. Marshall then addressed the Association on Tuberculosis. He urged the stock grower to greater care in giving pure air and ventilation when animals are kept in doors. Mr. Hinds discussed the paper. He said not one per cent of the cattle in Michigan had tuberculosis, but that did not indicate that it should not be carefully looked after. As a general rule it is best to destroy an animal afflicted with the disease rather than make an effort to cure it. Complete isolation of afflicted animals is the only safe way, if they are kept on the premises.

Dr. Waterman spoke of the swine disease as developed in Michigan. So far as noted, it has not been found to be the hog cholera or swine plague that afflicts the herds in the west. He urged farmers to be more careful in regard to sanitary measures and insisted that all dead animals should be carefully disposed of and not left to contaminate the well animals of the herd. When the disease breaks out, remove the well animals to clean, non-infected premises. Do this rather than remove the sick animals and still leave the well ones in the infected quarters. Sanitary precautions are far better than any effort to cure sick animals.

The Association then adjourned.

EARLY HISTORY OF THE COLLEGE.

A LETTER FROM HON. REUBEN GOODRICH.

Traverse City, Mich., May 17, 1898.

I. H. Butterfield, Esq.:

Dear Sir—Your letter just received and now that you refer to the Agricultural College, I wish to give you a little of its early history.

In 1855 I represented Genesee county in the State Senate, at which time there was a strong effort made to abandon the College scheme and sell the farm.

The land for the farm had previously been purchased and one wing of the College built between 1855 and 1857.

The Legislature were taken out to the farm one terribly cold day in January of 1857. The walls of the building were cracked, the furnace operated badly; scarcely enough heat could be produced to keep us from freezing with our overcoats on, and the whole matter looked very discouraging. This was the opportunity of the croakers to push their scheme of wiping out the college plans and selling the farm.

Upon that proposition the Legislature was very evenly divided. It looked like the scales were so evenly balanced that one vote either way would kick the beam. The friends of the measure asked for an appropriation—I think of $40,000—to proceed with the work, and the battle was over that or the sale of the farm.

At that time, Morgan L. Drake, a lawyer from Pontiac, was at Lansing pushing the scheme of a land grant to aid in building the Flint and Pere Marquette railroad, and was ready, willing and capable of serving members of the Legislature with free services, especially those who favored his hand grant enterprise. As this road was to start from Flint or some where in Genesee county, I was in sympathy with his scheme and having been raised on a farm, was in hearty accord with the Agricultural College project.

At this time the insane asylums were in their infancy, $15,000 had been appropriated for a beginning (a wing) to be constructed at Kalamazoo, and the same amount to begin the work of the Deaf, Dumb and Blind Asylum at Flint.

At Kalamazoo, instead of constructing a wing as required by the act, the trustees expended the entire sum in foundation walls for an extensive institution, which brought down much criticism upon the trustees' action. Kalamazoo county then had a large delegation or representation in the Legislature, and all favored the winding up of the Agricultural College and using the money to perfect their extensive plans for the Insane Asylum.

At Flint, instead of expending their $15,000 in laying foundation walls for a big asylum for the deaf, dumb and blind, they rented a building and fitted it for the school and almost at once were ready to receive pupils, and by January, 1855, had made such progress in educating the blind and dumb mutes that their exhibition before the Legislature showed such marked progress as to astonish all present, and they enabled the Flint institution to secure the entire appropriation (asked for by Mr. John P. Leroy of Pontiac and James B. Walker of Flint, with the other trustee whose name I have forgotten) without hesitation. I think the amount was $40,000.

At this juncture, when there seemed to be no doubt as to the permanency of the Flint institution, I went to Morgan L. Drake and had him draw up a bill providing for the removal to Lansing or within fifteen miles thereof, all state institutions except the Jackson State Prison, and that in the establishment of other State institutions, they must be located within that fifteen miles radius as a matter of convenience and economy, thus enabling the Legislature and all state boards to visit these institutions at a trifling cost of money and slight loss of time.

The introduction of that bill brought the Kalamazoo delegation in line, with some of their sympathizers, and saved the Agricultural College by a mere scratch, and we secured the appropriation asked for, which I think was $50,000.

Respectfully,
R. GOODRICH.

MISCELLANEOUS PAPERS.

INSECTS INJURIOUS TO GRAIN CROPS,

BY R. H. PETTIT, AGRICULTURAL COLLEGE.

In order to comprehend the changes that occur among insects and the terms used in describing them, it will be necessary to remember that the majority of insects normally pass through four stages, viz. the egg, larva or grub, pupa or cocoon, and adult. The injury to crops is usually done by the larvae and adult insects, but in fighting them it is often found that a species of insect is most easily destroyed in one of the other stages, as in the pupa or egg stages. So it is with the Hessian fly. This insect is most easily destroyed in the pupal stage, which corresponds to that of the cocoon in some insects. The life-history of the Hessian fly is briefly as follows: The adult fly appears about the first of September to lay the eggs on young sprouting wheat; they continue to fly until after the middle of the month. The eggs are laid on the upper side of the leaf and the young go down inside the sheath to about the level of the soil. Here they thrive on the succulent stem until ready to turn into the flax-seed or pupal stage, which they do late in the fall. The flax-seed stage derives its name from the resemblance of the pupae to flax-seed both in form and in color. These little flax-seeds remain in the young wheat till spring, when they crack open and each live pupa or flax-seed gives forth a small delicate fly that is at once ready to deposit more eggs. The eggs deposited by the spring brood hatch the same and the larvae behave the same as those of the fall brood until the flax-seed stage is reached and this flax-seed or pupa resembles that of the fall brood except that it is placed almost invariably above the first joint of the wheat stem between the true stalk and the sheath. Here it remains until after harvest, when the fly comes out to lay another crop of eggs.

As has been stated, the pupa of the second brood is placed just above the first joint. Now the presence of the flax-seed so weakens the stem that it easily lodges, bending over just above the insects. This is often the first intimation to the farmer that anything is wrong. Whenever such lodged wheat is seen to be common, it should be carefully examined, and if the flax-seeds are found, the stubble should be burned immediately after harvesting if possible, or else the ground should be immediately plowed. If we wait for a few weeks, then the fly will come out and no amount of plowing will do any good.

Other remedies are, the rotation of crops; trap-crops; late sowing of fall wheat; and the destruction of volunteer wheat. The insects are trapped by sowing strips of early fall wheat through what is to be the wheat-field. The flies, coming to oviposit, will find these strips in good condition and lay their eggs, ignoring the small sprouts of the real crop which are just commencing to show above the surface. These trap-strips may then be plowed and the grubs destroyed.

Late sowing is useful for the following reasons: The flies appear during the early part of September ready to lay eggs. If now we delay sowing until the middle of September, the flies will, many of them, not be able to lay eggs at all, and those that do will be obliged to do so on the grasses and volunteer wheat. It may be said in this connection that volunteer wheat should always be destroyed as soon as found. Parasites, whenever we see little round holes in the straw and on examination find that this hole extends through the side of the pupa, or flax-seed, then we know that parasites are present, and it is only on account of these parasites that we can raise wheat at all. These minute wasp-like insects feed on the living grub inside the flax-seed and destroy it. When these parasites are very numerous it may be understood as a very good sign and an indication that the flies will soon disappear.

Another insect which behaves very much like the Hessian fly is the wheat-stem maggot. These little maggots work above the top joint in wheat, rye, pigeon-grass, etc., eating off the succulent lower end of the stem, causing the head to turn white long before its time. Such white heads, if at all numerous, become very conspicuous. The only remedy as yet discovered is a rotation of crops.

The frit-fly works very much like the Hessian fly, and is hardly distinguishable from it. It may be controlled in the same way.

The joint-worm does some little damage although generally it may be ignored. It hardens short sections of the stem of wheat and passes the winter in the hardened segments. The best way to get rid of them is to use up all the straw and chaff or to burn up all that is likely to be left, before spring.

A very good general practice is to burn all straw and litter about the entire place.

INSECTS INJURIOUS TO STORED GRAINS.

While many insects destroy the growing grain and seeds, there are a few that attack it after it has been harvested and stored away. As they work here on a finished product which has a much higher market value than before it was harvested, and as the work is done quietly and often out of sight of the owner, considerable damage is often done before it is found out. We may class among these insects all the grain beetles, and there are a number of them, bean and pea-beetles, mites, etc.

It is usually a cheap and easy matter to destroy all these insects as well as any mice that may be in the building or bin if such building or bin be tight. One and one-half pounds of carbon bisulphide should be used for each ton of grain or one pound to 100 bushels. It should be poured out in shallow pans and placed on top of the grain. The bin must then be tightly closed and if necessary covered with blankets and carpets to render it tight. The liquid will change to a gas and permeate all the air-spaces between the kernels of grain, killing all insects as well as the rats and mice that may be in the bin. After twenty-four hours the bins should be thoroughly aired and the grain shoveled over if necessary.

All this work should be performed in the day time, away from fire and lamps, for the gas is very explosive. Care should be taken as well not to breathe the gas any more than is necessary for it is as poisonous to us as to the insects. The work, to accomplish good results and to be safe, must be done quickly and carefully to guard against danger and loss of the liquid.

THE FAMOUS FRUIT BELT REGION ALONG LAKE MICHIGAN'S EAST SHORE.

BY L. N. KEATING.

Says C. Hart Merriam, Chief of the Biological Survey of the United States, "The Biological Survey claims to define and map the natural agricultural belts of the country to ascertain what products of the soil can and cannot be successfully grown in each district. The farmers of the United States spend vast sums of money in trying to find out whether a particular fruit, vegetable or crop will thrive in localities where it has not been tested. The cause of their failure in the great majority of cases is climatic unfitness. The quantity, distribution or inter-relation of heat and moisture may be at fault. What the farmer wants to know is how to tell in advance whether the climatic conditions of his farm are fit or unfit for the particular fruit or crop he has in view. From a study of the geographical distribution of native animals and plants, it has been learned that the United States may be divided into seven belts or zones with a number of minor areas, each of which is adapted to the particular associations of animal and vegetable life; that is, the distribution of native animals may be co-ordinate with the sucessful distribution of cultivated crops or fruits. All of the climatic or live zones of the world except the humid tropical are represented in this country. The study of the products of distant lands will result in the further discovery of fruits and vegetables which can be introduced into this country in the proper zones."

This Biological Department issued, in 1897, a map showing these live zones, so-called, of the United States. The dotted parts of this map indicate the humid divisions of these zones. For example, rainy portions of New York, Pennsylvania and the shore portions of New England are the same as all of the lower peninsula of Michigan, excepting the narrow strip along the east shore of Lake Michigan, known as the Fruit Belt Region; and this narrow strip is the same as to humidity as Illinois, Indiana, Ohio, Kentucky, parts of Tennessee, Alabama, Georgia, and North Carolina, thus showing as to moisture the lower peninsula of Michigan is divided into two sections. As to humidity, this fruit belt region appears to be a tongue of land, extending along the east shore of Lake Michigan. Its width is dependent upon location and how far the shore line is exended west into Lake Michigan. The territory along the shores of Lake Superior resembles the Dominion of Canada as to humidity. There are climatic reasons growing out of the proximity of this fruit belt region to Lake Michigan that come in to change its vegetable and fruit growth as to temperature, while the humidity is as stated. There is no fruit belt region like this on the west shore of Lake Michigan —the Wisconsin shore—because the vast continental stretch of land, lying west of Lake Michigan, and south-west and north-west of the Rocky Mountains produces different conditions in climate both in summer and in winter, and we cannot find a similar fruit belt section along the other shores of these Great Lakes. This fruit belt section comes from these climatic conditions which are caused by the interposition of this vast body of Lake Michigan between it and the great western continental territory. Lake Michigan is a buffer to the hot winds that come off the prairies in the summer, for the prevailing winds are from the south-west: also to the cold storms of the prairies in the winter, and the artic winter winds from the north-west. When these winds strike this great body of water they absorbe a large amount of humidity, so the temperature is also changed by them, and the effect is felt all over this narrow tongue of land lying along this east shore. Owing to Lake Michigan not being of the same width, this fruit belt secton not being in a straight line along this Lake, these south-west winds, laden with humidity are not at all portions of this fruit section, similar as to dampness, besides other climatic changes. It is found that the counties that project further into the Lake have climatic conditions not found in other counties, situated farther east. The original timber in this section is not the same. In some portions it ran to pine, oak, and hemlock; while in other portions of counties it was largely hard-wood. And the strength of the soil is not the same through this section, some counties having more clay than others.

In the summer-time, Lake Michigan is a cooler of the temperature that comes into this section, and cool nights are the result, with more or less fog or dew. In the winter-time it is a thrower-off of heat, so that often the temperature is above zero in this section, when forty to sixty miles inland, it is to be found ten to fifteen degrees below zero.

We have not yet got to the full analysis of the results produced by these south-west winds coming across Lake Michigan and absorbing this moisture, nor the full effects of the climatic situation of this fruit-belt region. What would have been the effect if this fruit-belt strip of land was heavy clay, the same as the west shore of Lake Michigan in Wisconsin? It is my conviction that this section would then have been a heavy grass country and fruit would have been a failure. From the excessive moisture there would have been a tendancy to fevers and malerial sickness. Whereas this excessive moisture here found in this region is the counterpoise of the drift soil which furnishes a warm, dry surface for the rapid growth of fruit and wood.

The early farmers of the fruit belt section were employees of lumbermen, largely unskilled in the growing of fruit and having but little desire to learn the peculiarities of this section, of which they were ignorant in the other parts of the country that they came from. The result is that these pioneer farmers are rapidly going out, giving way to fruit-growers who have educational skill and knowledge of hom to handle this drift soil in this section to the best advantage. The heavy wood and timber growth of this fruit belt section is a sufficient argument that the wood necessary to form orchards receives a rapid growth. As this humidity is not so great as in Oregon we do not find here rapid growth of orchard wood, resulting in bursting of bark and a short life to the fruit trees. Then wherever a heavy timber growth is found in the United States it is in a humid section, and it is a fair indication that a heavy orchard growth may come thereafter.

Owing to the fact that the soil in this fruit belt country is drift, there is a scarcity of gravel, so that the highways that the farmers ought to have composed of gravel and clay are lacking; and many a land-looker has been prevented from settling in this region owing to these sandy roads, being ignorant of the fact that a drift soil will produce results in a humid atmosphere—other elements being equal—that will raise greater crops than where he comes from.

Another singular thing is that the taste and quality of fruits are not the same in these different zones of the United States. For instance, I have seen Northern Spies in perfection as to looks in the orchards of New Mexico, that did not resemble in taste the Michigan Spies. They are more like the Ben Davis apple of Missouri—fine lookers, but not the same as to taste as when planted farther north. The Missouri peach has a bright, fine color: the sun paints it. As a rule the peach in this fruit belt section of Michigan does not have as many fine sunny days as the Missouri peach, and it has a dull color. But when we come to flavor, it excels the Southern peach, and is juicy, while the Southern peach is a more musk-melon type of flesh.

Although I may be criticized for making this statement, the Michigan peach of the fruit belt section is the best canning peach in the United States. It has a fine acid flavor that will hold out in a can, and it does not come onto the table from the can, insipid. Although it may not equal the California, the Missouri, the Georgia, or the Maryland peach as to looks. It will therefore be seen why climatic reasons change the type and character of fruit, and why this fruit belt region has particular advantages not to be found in other fruit belt sections of the United States.

It may be stated as a rule as to agricultural wealth, that where a country or section has diversified crops, has money coming in, even in small quantities, for a large portion of the year, in time, that section will get richer than the county where they have but one paramount crop. I know of one county in this fruit belt section of Michigan that has now but seventeen thousand people, and it is a fair estimate that its annual export trade of potatoes, fruit, lumber, and all kinds of crops that it ships out of the county is equal to $300,000 a year poured into this County from outside buyers. This, coupled with the fact, that in this fruit belt region the farms have to be small in acreage, owing to lack of help, the tendency being to acquire forty acre farms, shows that the population is getting a more equal distribution of wealth than countries where there are large farms. It therefore follows that a county of small farms is far better for the average man to settle in than one where large farms are the rule.

The State of Michigan is promoting the holding of Horticultural meetings, and sending trained experts to these meetings to answer the questions of interested persons and to deliver addresses on subjects relating to fruit-growing, The effect of these meetings is a lifting up of the fruit-growers to a better idea of climatic situations and what is necessary to be done to make the fruit crop pay. It is the educated farmer who is now going to the front, and the bookman is leaving the farmer who takes no agricultural paper and snorts at education far in the rear.

There are two classes of farmers who have no use for the light soil, and who firmly believe that the soil of the farms they live on is the best on earth. One is the possessor of the rich black prairie soil of Illinois and other Western States, and the other is the owner of heavy clay land such as is found in the interior of Michigan and in Eastern States.

These two classes of farmers are deeply prejudiced in favor of lands such as they own. If told that there was a stretch of land along the east shore of Lake Michigan that was drift soil, formed by the action of the "Great Lake" in receding its waters, in some places heavy clay and in others light sand, and that year in and year out, owing to climatic reasons, this fruit belt section would earn more agricultural wealth than where he lives, neither one of these classes of farmers would believe it.

Except in Africa there is no large continental area of land that has big lakes in it like these Great Lakes of the United States. Here is a strip of land, of drift soil, extending from New Buffalo to Mackinaw along the east shore of Lake Michigan, a distance back of from twenty to forty miles, that has peculiar climatic conditions. There is nothing like it elsewhere in the United States. I will briefly state some of the conditions of this fruit belt. Increase of humidity in warm weather means an increase of sensible heat: in cold weather, the reverse happens. The actual temperature may be one thing, and the sensible temperature (as to feeling) may be another thing, owing to this increase of humidity. Winds tend to the production of humidity. Vast bodies of water like the Great Lakes situated in the midst of large areas of land, have a climatic influence on shore territory, the full extent of which is not known. Continental or large tracts of land without lakes become more heated in summer and colder in winter. The climate on the Eastern shore of Lake Michigan in this fruit belt section is better than on the western shore of this lake as to fruit growing, its continental area of land lying to the west of Lake Michigan, producing a different climatic situation. When you understand that you can take the whole of New Jersey, Maryland, and Deleware and drop these three states into Lake Michigan, and that the winds are south-west across this Lake in the fruit-growing season as a rule, then you can understand how the temperature is equalized on this shore.

While the soil is sandy as a rule, being a drift soil, yet there are alkaline substance in it that promote vegetation. That the lower peninsula of Michigan was once under the waters of the Great Lakes is apparent from the following reasons: there extends through to Mackinaw north and south in the center of the State a higher elevation than the other lines of these lakes which surround it, and from this higher elevation, streams flow east and west into Lake Michigan and Lake Huron, the soil is what is called drift by geologists, and is caused by deposit from the waters of these lakes. This soil is more or less impregnated with gypsum particles, showing that at the bottom of these great lakes there must exist great areas of gypsum rock, which the waters have disintergrated these particles from and mixed in this deposit. This is also shown by the out-cropping of gypsum rock near Grand Rapids, and in other portions of this shore line. The relation between weather and climate is not clearly understood. By weather is meant the condition of the atmosphere at any one time with regard to its temperature, humidity, motion, etc., whereas climate is made up from the record of these observations. The simple thermometer does not measure temperature as felt by animal life. There are two temperatures, the actual and the sensible, and it may be that vegetable growth and timber growth is also affected in the same manner by this sensible temperature, so that even the thermometer does not indicate the best tests for fruit-growing.

As the drift soil of this fruit belt region has thus been created by the action of water, by which earthy materials have been separated into coarser and finer portions, you will find on sections of land in this fruit belt country a forty which may be heavy clay, and an adjoining forty of light drift soil, so that this fruit belt country is what may be called spotted land. In general, soils that are made up in this way of clay will hold more water than sandy or gravelly soil, but the motion of water through them is slower, and loss by drainage and surface evaporation is less rapid, so that coarse grained soils that are sandy are quickly saturated with rain but hold less of it, and dry out sooner by drainage or evaporation. They also have less drouth resisting powers, though easier to cultivate. I do not mean they do not have drouths in this fruit belt section, but I do mean that this drift soil has less drouths, and that surface cultivation in this humid atmosphere will pull crops through, when, in the interior of the State, the same drouth will injure and destroy crops. As the humid atmosphere of this fruit belt region largely overcomes this question of drouth on lighter lands, the same objection to them does not exist is in the interior portion of the country where the prairie or clay farmer lives. Again, a clay soil in the interior of the continent, of close texture, impervious to roots and water and perhaps lumpy, may become through poor cultivation chemically rich, but practically barren because its compactness makes it difficult for roots to reach and use its source of plant food; whereas a sandy or drift soil may show less of phosphoric acid, lime, nitrogen, or potash, but its loose texture may produce better crops. On loose, porous or drift soil subsoil-plowing results in diminishing crops of all kinds. On the other kind, surface cultivation gives better results. Farmers used to subsoil plowing do not understand this, and they have to change their method when they move into this fruit belt section. The amount of lime in the soil necessary for fertility varies according to the kinds of soil. This explains why the alkali or gypsum particles in this drift soil produces such luxuriant vegetation, and that clay soil requires more lime than sandy.

Take an inside farmer who owns clay or prairie land into this fruit belt region and show him maple trees and beech trees such as grow on clay land in the interior and he cannot understand it, because he does not know that this drift soil is full of alkaline, gypsum substances, furnishing a better growth or vegetation than clay land, and that these trees reach up into a humid atmosphere that his trees do not grow to. You will notice that the beech and maple trees in this fruit belt region grow long trunks and to a greater height than at interior points: there is more lumber in them. The interior beech and ample are short trunked with low branches, while the fruit tree section maple and beech grow to a great height with clean trunks.

That this land is drift soil is apparent also from the fact that the East shore of Lake Michigan is irregular and is different from the west shore of the Lake, and there are numerous lakes now formed into harbors on this East shore which increase the water erea. Here is a stretch of land running north and south along the lake shore from twenty to forty miles in width from New Buffalo to Mackinac. As a matter of climate, there is no strip of land in the United States like it. As a matter of cool atmosphere in the summer and fine nights for sleep and warmer winters, there is not a strip of land like it in this country. As a pure drift soil of all kinds, mixed with alkalines, producing a fine growth of vegetation and of tree plant life it cannot be equaled. And yet, farmer after farmer from the interior of the country will travel for miles through this fruit belt region and cannot understand how this drift soil can raise anything.

There are peach trees in this fruit-belt section that have borne peaches for eighteen to twenty-five years. They are plum orchards as thrifty as those of Oregon or California. They raise prunes the best this side of the Rocky Mountains. It is the natural home of the cherry. The pear does not do as well. With proper cultivation, adapted to this climate and this soil, the apple is a success. It is not a question of quality for berries or grapes, but the limitation is to prevent too large a quantity. The potatoes from this section rank high on the Chicago market, and are a profitable crop.

As a rule forty acres is enough for one farmer, for with his fruit and his potatoes and his other crops, he has work all the year round, and his farm pays him better than a larger farm East or West growing one predominant crop. He has water and railroads for transportation.

The area of this fruit-belt is limited. Its wealth is increasing. It may be asked if the enormous planting of orchards in this section will not tend to loss. The fruit tree has its limitations. Consideration must be given to the fact that some trees die young: also that the commercial value of a tree is claimed to be within the first eight years of its fruit life, and after that, it must be replaced or kept up in order that the orchard may be a profit producer. Thus it will be seen that new orchards must be planted to take the place of old ones that die out. This rule extends to all tree fruits.

It may be said that the fruit industry is a progression of crops from the South to the North, and the problem is for the fruit crop of the North to get out of the way of the same crop coming from the South. So the tendency in fruit-growing i sin the direction of the fruit supply of Northern orchards to come on later, after the Southern ones are out of the way.

I have seen it above zero in this fruit belt section, when sixty miles inland it was ten to fifteen degrees below zero in the winter time. I have seen men go from this fruit belt section at Muskegon to Grand Rapids, which is forty miles in the interior, dressed in woolens, complain of the heat at Grand Rapids. I have seen persons thinly clothed, coming from Grand Rapids, shivering in the cool air of this lake belt. In fact, as you leave the interior of Michigan and come towards this East shore, the change in the climate is perceptible on the cars as soon as you get within this fruit belt section.

The farmers within this fruit belt section are learning how to cultivate this soil and to bring these diversified crops of fruits. The great problem with them is to find a forage crop for their stock that can be turned into a fertilizer later on, and many of them are now experimenting with crimson clover and cow-peas.

Some of the finest and heaviest timber that Michigan has had has been cut in this fruit-belt region. And, as you ride along and see the acres of stump land with heavy stumps showing magnificent growths of timber, you gradually reach the conclusion that this drift soil must have in it, coupled with climatic situation, a growth of tree life that is deceiving. In fact it may be laid down as a rule that any section that would grow large timber will raise plenty of fruit, provided the climatic situation is favorable.

Another singular thing is that the growth of vegetation is from ten to twenty days longer in this fruit belt section than in the rest of Michigan: That is, there is less danger from late frost in the spring, or early frost in the fall. I do not say they do not have these late frosts and early frosts, but the chances are more in favor of the former in this section if any come.

With this section having limitations as to acreage, width, and length, and raising so many kinds of fruit, and vegetable products as this does, the careful farmer who knows his business can make more money in it than on richer soils in the interior of the country where there is not such a favorable climatic situation.

There orchards appear to do better on hilly lands where they face the north. The hilly orchards have what they call air drainage, and facing to the North they do not come out in blossom so early in the spring as where they face the South, or any other direction, which helps to avoid late frosts in the spring.

In conclusion, this strip of land along the shore of Lake Michigan is highly favored as to climatic situations for orchard and fruit growing. And the facility for shipping by boats to large cities like Milwaukee and Chicago with connections out of these towns, cannot help, but take care of the large amount of fruit. The main problem is to so adjust the coming forward of this fruit that it does not complete with Southern fruit coming to these cities. Therefore all kinds of fruit and berries in this fruit section should be of later varieties.

APPLE ORCHARDS IN MICHIGAN IN THE YEAR 1897.

AS REPORTED BY EDWIN C. REID, SECRETARY STATE HORTICULTURAL SOCIETY

Counties.	Acres.	Counties.	Acres.
Allegan	7,967.15	Livingston	4,637.00
Barry	5,354.37	Macomb	5,580.25
Berrien	7,227.49	Mason	2,191.75
Branch	5,392.75	Monroe	4,839.62
Calhoun	4,758.14	Montcalm	3,580.50
Cass	3,762.25	Muskegon	1,873.75
Clinton	6,367.70	Newaygo	2,265.37
Eaton	6,638.25	Oakland	10,265.25
Genesee	6,256.75	Oceana	3,210.75
Grand Traverse	2,676.00	Ottawa	4,340.38
Gratiot	3,834.68	Saginaw	3,515.99
Hillsdale	6,684.25	Sanilac	3.922.33
Huron	3,495.24	Shiawassee	5,087.25
Ingham	5.960.75	St. Clair	5,146.12
Ionia	6,273.58	St. Joseph	3,356.85
Jackson	5,307.90	Tuscola	5.146.62
Kalamazoo	3.956.53	VanBuren	7,578.24
Kent	7,749.25	Washtenaw	7,046.25
Lapeer	5.173.87	Wayne	5,518.71
Lenawee	7,547.25		

PEACH ORCHARDS IN MICHIGAN IN THE YEAR 1897.

Counties.	Acres.	Counties.	Acres.
Allegan	7,610.12	Newaygo	670.62
Berrien	3.181.40	Oakland	958.50
Ionia	2,422.95	Oceana	4,178.50
Kent	7,485.75	Ottawa	3,237.52
Mason	1,860.66	VanBuren	5.361.82
Muskegon	812.75	Washtenaw	1,270.75

It is doubtful if there will be a single ox team employed in upper peninsula forests the coming winter. Twenty-five years ago all skidding was done with oxen, it being thought that horses would calk themselves in the deep snow, and that they could not handle the heavy logs. This was found to be erroneous, and horses are now used exclusively for lumbering work, except where steam skidding machines are in use, which is at but a few camps, the steam loggers being better adapted to southern forests, where snow is unknown.—Menominee Herald.

MICHIGAN STATE AGRICULTURAL SOCIETY.

Report of the transactions of the society for 1897 and proceedings of the winter meeting of the executive committee January, 1898.

OFFICERS OF 1897-8.

PRESIDENT—WILLIAM BALL, Hamburg.
VICE-PRESIDENT—I. H. BUTTERFIELD, Lansing.
TREASURER—C. W. YOUNG, Paw Paw.
SECRETARY—H. S. FRALICK.
Society address, Grand Rapids.

EXECUTIVE COMMITTEE.

TERM ENDING JANUARY, 1898.

E. W. Hardy	Howell, Livingston County.
Frank Maynard	Jackson, Jackson County.
F. L. Reed	Olivet, Eaton County.
N. J. Kelsey	Marshall, Calhoun County.
H. R. Dewey	Grand Blanc, Genesee County.
R. D. Graham	Grand Rapids, Kent County.
John Lessiter	Pontiac, Oakland County.
H. H. Hinds	Stanton, Montcalm County.
F. E. Skeels	Grand Rapids, Kent County.
M. J. Gard	Volina, Cass County.

TERM ENDING JANUARY, 1899.

Eugene Fifield	Bay City, Bay County.
L. G. Townsend	Ionia, Ionia County.
F. H. Latta	Battle Creek, Calhoun County.
A. H. Zenner	Detroit, Wayne County.
L. W. Barnes	Byron, Shiawassee County.
W. P. Custard	Mendon, St. Joseph County.
H. D. Cutting	Tecumseh, Lenawee County.
M. P. Anderson	Midland, Midland County.
C. E. Lockwood	Washington, Macomb County.
W. E. Boyden	Delhi Mills, Washtenaw County.

EX-PRESIDENTS.

Charles Kipp	St. Johns, Clinton County.
E. O. Humphrey	Kalamazoo, Kalamazoo County.
W. L. Webber	East Saginaw, Saginaw County.
Geo. W. Phillips	Romeo, Macomb County.
Wm. Chamberlain	Three Oaks, Beriren County.
A. O. Hyde	Marshall, Calnound County.
T. W. Palmer	Detroit, Wayne County.

STANDING COMMITTEES AND EXECUTIVE SUPERINTENDENTS, 1897.

BUSINESS COMMITTEE.

Eugene Fifield, W. P. Custard and Secretary.

TRANSPORTATION COMMITTEE.

H. R. Dewey, F. E. Skeels and Secretary.

RECEPTION COMMITTEE.

A. O. Hyde, William Chamberlain.

FINANCE COMMITTEE.

M. P. Anderson, H. R. Dewey, C. E. Lockwood.

PREMIUM LIST COMMITTEE.

C. E. Lockwood, L. W. Barnes, W. E. Boyden, M. P. Anderson, E. W. Hardy, John Lessiter, R. D. Graham.

COMMITTEE ON RULES.

H. R. Dewey, F. H. Latta, F. L. Reed.

PROGRAM COMMITTEE.

Eugene Fifield, W. P. Custard and Secretary.

PRINTING AND ADVERTISING COMMITTEE.

H. H. Hinds, Eugene Fifield and Secretary.

GENERAL SUPERINTENDENT.

Eugene Fifield.

CHIEF MARSHAL.

L. G. Townsend.

EXECUTIVE SUPERINTENDENTS.

Cattle—W. E. Boyden.
Horses, speed—Eugene Fifield.
Horses, Roadsters, Draft and Pony Classes—John Lessiter.
Sheep—C. E. Lockwood.
Swine—L. W. Barnes.
Poultry—H. D. Cutting.
Dairy, Bees and Honey—M. J. Gard.
Farm and Garden Products—F. L. Reed.
Vehicles—H. R. Dewey.
Machinery—Frank Maynard.
Manufactured Goods, Music and Art—M. P. Anderson.
Needle Work and Children's Work—F. E. Skeels.
Miscellaneous and Special Exhibits, Except Specials on Fruits—Frank Maynard.
Horticulture—R. D. Graham.
Gates—W. P. Custard.
Police—E. W. Hardy.
Forage—W. E. Boyden.
Agricultural Implements — F. H. Latta.
Booths and Privileges—F. E. Skeels.

REPORT OF THE JUDGES FOR ELECTION OF OFFICERS OF THE SOCIETY, HELD ON THE FAIR GROUNDS AT GRAND RAPIDS, THURSDAY, SEPT. 9, 1897.

The following persons having received the highest number of votes for their respective offices, are hereby declared duly elected officers of the society for 1898:

For President, William Ball	294
For Vice President, I. H. Butterfield	295
For Treasurer, C. W. Young	295
For Secretary, H. S. Fralick	339

EXECUTIVE COMMITTEE.

E. W. Hardy	339	Frank Maynard	338
F. L. Reed	339	N. J. Kelsey	339
H. R. Dewey	295	R. D. Graham	295
John Lessiter	295	H. H. Hinds	293
F. E. Skeels	293	M. J. Gard	339

We further declare that we publicly announced the result of the election immediately after the result of the canvass of the votes so cast.

GEORGE W. STUART,
E. M. SHARP,
S. S. BAILEY,
Judges.
WILLIAM BALL, President.

We, the undersigned judges of the election of officers of the Michigan State Agricultural Society held this 9th day of September, 1897, having been duly sworn, do hereby declare each for himself, that he will faithfully and impartially act as judge of such election.

(Signed) GEORGE W. STUART.
S. S. BAILEY.
E. M. SHARP.

The annual winter meeting of the executive committee was held at Sweet's Hotel, Grand Rapids, January 10, 1898.

Called to order by the president.

Roll called: quorum present.

The president read his address.

PRESIDENT'S ADDRESS.

"Gentlemen of the Executive Committee of the Michigan State Agricultural Society:—It has long been a custom that the president of the society shall have something in the form of an address at the yearly meetings of this committee. For some years past this custom has not been followed closely, owing to some peculiar conditions affecting the society, necessitating adjournment to some future time in order that the committee might be better informed regarding the place of holding its annual fair, how to partially adjust some settlement of the financial embarrassments surrounding the society as well as some minor matters connected with fair management. It may not be out of place at this time to call attention to some of the conditions which have environed the society for quite a number of years, as well as to mention some of its former successes and failures in years more remote. Since the organization of the society, it has held forty-eight exhibitions or fairs, most of which, if not all, were a credit to the management and a great aid in developing the agricultural resources of this great State of Michigan. The society for many years was really the only public means of improvement in stock breeding, in advanced agriculture, in mechanic arts, and in the general development of the State. While the benefits now derived from our Agricultural College, the govermental experiment stations, farmers' organizations of various kinds, agricultural literature and the like, it may not have the same value it once had as an educator, but it still fills a very important place in the further development in agriculture, stock breeding and kindred arts in the State of Michigan. In no way can the improvements in stock breeding be so well brought to the notice of the people of the State, as their exhibit at a State Fair. In no other way can a comparison between the different cereals of the State, the improvements in machinery, in fine arts, in manufactures, be so well shown as by good displays made yearly at the exhibitions of the State society.

The important part that State Fairs take in the improvement in the different departments heretofore mentioned, is recognized in many of the states most advanced in agriculture, by liberal State donations in the form of permanent locations, buildings and money to pay premiums. The society which you represent is a creature of legislation and received a small conditional State donation for a few years. This soon ceased and the society was left to take care of itself, which it has done up to the present time, with varying success. It has seen days of adversity, when members of the executive committee pledged themselves to stand between the society and bankruptcy, in order that the annual exhibition might be held. It has seen days of prosperity since then, when it could show an ownership of $28,000 in United States government bonds, and in two years from that time, after two unsuccessful fairs held in Kalamazoo, poorer by $15,000, and in three or four years more, with a bare surplus on hand. Such was the condition of the society when it located permanently in Lansing. The society was obliged to improve the grounds, to put up new buildings and prepare for holding its annual fair. An amount approximating $18,000 was used in making improvements, and the society became a debtor to that amount. For two or three years the society, from receipts received at its fair, was enabled to pay its insurance, interest, premiums and running expenses, and if my memory is correct, a small amount of indebtedness. Then came the year of 1892, when rain prevented a large attendance, and at the close of the fair the society was several thousand dollars more in arrears. With the debt mentioned, interest increasing, the premiums of that unfortunate year unpaid in part, the society has been struggling until by an agreement with its creditors last year, the society disposed of what it considered its equitable rights in the buildings and grounds in Lansing to its creditors, and about $18,000 of indebtedness wiped out and the society today owes part of the premiums of the unfortunate year and $25,000 with interest, to parties in Grand Rapids. These matters are mentioned that those who think bad management may have brought on the large indebtedness under which the society has been groaning can know for what purpose the debt was contracted. To be more particular, in the year 1892, which has been mentioned, on account of the wet weather during the week, the society ran behind about $6,000. Up to that year the society had been able to meet its expenses, pay its interest and insurance besides paying between $3,000 and $4,000 of its indebtedness. This was during the years of 1889, 1890 and 1891 after locating in Lansing. Owing to the Columbian Exposition held in Chicago in 1893, no fair was held. The interest continued to increase, so that at the end of the year 1894, three years' interest was unpaid, amounting to nearly $4,500, which added to the principal, amounts to about $22,000. With the exception of the years 1892 and 1896, the fair has paid its expenses, premiums, interest, insurance and some principal, so that it can be said the fair has proved fairly successful financially.

There is no doubt but the hard times of the last few years have been injurious to the financial success of fairs as well as in most kinds of business. Even with state aid, if I am correctly informed only one state fair last fall had its balance sheet on the right side of the ledger. Michigan State Fair paid expenses, and as I am informed by the report of the Business Committee, had a few dollars to spare. The future of state fairs, so far as the financial outcome is concerned, it problematical.

So many sources of pleasure and comfort are now provided, cheap railroad excursions, especially Sunday excursions, the fad of street fairs which must have its run, all tend in a greater or less degree to lessen attendance and interest in agricultural fairs.

Shall the State Agricultural Society hold a fair in 1898? This is a question of much importance and should have very careful analysis.

The exhibitions of the society have in the past been of a very high order and there is little doubt about future fairs if they should be held. The society is not in a position to hold a fair that will not pay its way. The amounts received at the gates for the last four fairs have not been encouraging. The expenses for the last three years have exceeded or equaled the receipts. Can the premium list be reduced in monied value and still offer sufficient inducements to exhibitors to patronize the fair? If so, where shall the reductions be made? Can the expenses of running the fair be reduced? If so, in what direction? Excepting the secretary and treasurer, all members of the Executive Committee do-nate their time and receive only their traveling and hotel expenses from itemized bills.

These are matters for consideration. The fair to be a success, must be self-sustaining. What new methods or means can be introduced that will warrant a larger attendance?

Should the citizens of Grand Rapids or any other city desire the exhibition, what will they do to insure increased interest and greater receipts? Will the railroads centering in the locality where the fair may be held do anything by way of cheaper rates and a lessening of freight and switching charges? In the past, the members of the Executive Committee who have to be on hand some days previous to the fair, have had to pay full fare to the place of exhibition and from there to their homes, and also to some help besides because the cheaper rates do not come in force until the week of the fair. To obviate this additional expense a few return papers have been issued in a few instances. Can the roads which are benefited to a certain extent by the holding of the fair, be induced to help reduce expenses by allowing those who give their time for the purposes of their society, the same privileges accorded to visitors? The meetings of the Executice Committee and the Special Committee which have to meet several times during the year to prepare and make arrangements for the fair have to pay full rates both ways. Would it not be well for this committee before deciding to hold another fair, to confer with railroad officials and see if some arrangement cannot be made by which permits for half fare shall be issued to such committees in the discharge of such duties, when proper assurances are given that such privileges will not be abused?

If any benefits accrue in the exhibitions of the society to any except those engaged in helping make the fair a success of their exhibits and those who patronize it, it must be to the locality where the fair is held and to the railroads, by the increase of patronage owing to the exhibition. To me it seems that these are matters of interest and should be given attention in deciding the question of holding another fair.

Some considerable difference of opinion has existed among members of the committee relative to the time of holding the fair, some thinking a later date preferable to the early part of September, the argument being that farmers would be more nearly through with wheat seeding, corn cutting and bean harvesting and could better afford the time to attend the fair than if held earlier. Some few criticisms have appeared which may have led to the belief that the financial affairs of the society were controlled by a coterie of members, in a manner that deprived the public of what was being done. This is entirely misleading, as the books of the society are for the inspection of any person interested in knowing their contents. The sources from which such statements were derived would not be hard to find. The Secretary of the State Society is obliged by Article VIII of the Constitution to make a report to the society at the meeting of the Executive Committee next after each annual meeting and fair of the society, which report shall state by items all moneys received by him and shall also state the dates at which the same were paid over to the treasurer and the amount at each time. Such report shall also show all warrants drawn on the treasurer and the specific purpose for which each warrant was drawn.

In addition to this, a report from the Chairman of the Business Committee is submitted, containing in detail and by items, all expenses incurred during the year. These reports are published yearly by the State Board of Agriculture in its yearly report. These statements were made so that if any were misled by the criticisms referred to above, they could easily ascertain the truth of the whole matter. Owing to the fact that the railroads sold coupon tickets to the fair for the society, which took in some instances, some weeks before a settlement could be effected with the roads, an apparent delay in furnishing a statement of the results of the fair financially was presented, but no intentional delay in making such report. It is to be hoped that all persons interested in the affairs of the society will avail themselves of the privilege of listening to the financial reports of the society at the annual meeting of the Executive Committee where convenient. If it is decided to hold a fair in 1898, the strictest economy should be seen in every department connected with the management of the exhibition. It seems to me that the improvement shown to quite an extent in the business interests of the country would tend to an increased attendance at another fair. If I can judge correctly of the conditions in business circles, they are hopeful and are likely to prevail for some time to come. If a fair could be made to pay expenses last year, there is hope that a profit might be secured this year.

The society is in a better condition financially than it has been for quite a number of years. All realize the necessity of economy and all will be done that can be done to make a fair a creditable one so far as exhibits are concerned, and to pay the few remaining debts of the society. I have thought best to throw out some suggestions that to me seemed worthy of mention. They are for your consideration."

It was moved that a committee of three be appointed to report subjects from the president's address for consideration. Messrs. Maynard, Dewey and Graham were appointed such committee.

The secretary submitted his report of the entries and awards at the fair of 1897.

The following shows the entries in each class and division:

Division A—Cattle.

Class.			
1.	Shorthorns	33	
2.	Devons	33	
3.	Herefords	31	
4.	Jerseys	72	
5.	Galloways	32	
6.	Aberdeen Angus	28	
7.	Holstein Friesians	18	
8.	Red Polled	43	
9.	Fat Cattle	18	
10.	Sweepstakes for Dairy Cows	6	
	Total		314

Division B—Horses.

11.	Standard Bred Roadsters	21	
12.	Roadsters not Standard	20	
13.	Carriage and Buggy Horses	4	
14.	Saddle Horse	22	
15.	Horses of All Work	5	
16.	Cleveland Bays	1	
17.	French Coach Horses	1	
18.	Hackneys	3	
19.	Percheron or French Draft	8	
20.	Clydesdales	12	
21.	Grade Draft	0	
22.	Shetland Ponies	0	
	Speed Entries	123	
	Total		279

Division C—Sheep.

23.	American Merinos	113	
24.	Rambouillet Merinos	31	
25.	Delaine Merinos	38	
26.	Merinos not registered	19	
27.	Lincolns	46	
28.	Leicesters	32	
29.	Cotswolds	46	
30.	Shropshires and Specials	70	
31.	Hampshires	47	
32.	Oxfords	20	
33.	Southdowns	38	
34.	Tunis Sheep	0	
35.	Fat Sheep	13	
	Total		513

Division D—Swine.

36.	Berkshire and Specials	43	
37.	Essex	30	
38.	Suffolk or Small Yorkshire	44	
39.	Poland China and Specials	130	
40.	Duroc Jersey	48	
41.	Chester White, Cheshires and Large York	78	
	Fat Hogs	2	
42.	Victoria	57	
	Total		432

Division E—Poultry.

43.	Poultry	831	
	Total		831

Division F—Grain and Vegetables.

44.	Grain and seeds	132	
45.	Roots and vegetables	250	
46.	Professional display	6	
47.	Flour, meal and feed	20	
48.	Special county institute	0	
	Total		408

Division G—Dairy Products.

49.	Butter, cheese, etc	23	
50.	Sugar, bread and pickles	54	
51.	Soap, toilet articles, etc	1	
	Total		78

Division H—Bees, Honey, Etc.

52.	Bees and honey	34	
	Total		34

Division I—Farm Implements.

53.	Farm implements	4	
	Total		4

Divisions J and K—Vehicles and Machinery.

54.	Vehicles, etc	30	
	Total		30

Division L—Manufactures, Etc.

55.	Wool samples	8	
56.	Leather and rubber	0	
57.	Articles of furniture	9	
58.	Stoves, iron work, etc	0	
	Total		17

Division M—Clocks, Jewelry, Etc.

59.	Clocks, jewelry, etc	0	
	Total		0

Division N—Painting, Drawing, Etc

60.	Painting, professional	230	
61.	Painting, amateur	117	
62.	Industrial art	60	
	Total		407

Division O—Needle Work, Etc.

63.	Plain needle work	34	
64.	Embroidery	250	
65.	Crochet and knit work	110	
66.	Children's department	43	
	Total		437

Division P—Miscellaneous Articles.

67.	Miscellaneous	97	
68.	Household articles	10	
69.	Printing and stationery	0	
	Total		107

Division R—Horticultural.

70. Artistic exhibits of horticultural products	5	
71. General collection fruits for family use	6	
72. General collection of market fruits	5	
73. Special exhibit peaches	3	
74. Special exhibit pears	15	
75. Special exhibit plums	9	
76. Special exhibit grapes	25	
77. Single plates of fruits—		
Apples	202	
Pears	128	
Peaches	53	
Plums	80	
Grapes	83	
Quinces	8	
Cranberries	0	
78. Dried, canned and preserved fruits and jellies	20	
79. Plants and flowers shown in beds	10	
80. Plants in pots	88	
81. Cut flowers, boquets and floral designs	42	
Total		782
Department of specials	164	
Total		164
Non-enumerated fruits	73	
Total		73
Total entries in all departments where premiums are offered		4,910

Recapitulation.

Division A. Cattle	314
Division B. Horses	279
Division C. Sheep	513
Division D. Swine	432
Division E. Poultry	831
Division F. Grain and vegetables	408
Division G. Dairy products	78
Division H. Bees, honey, etc	34
Division I. Farm implements	4
Divisions J and K. Vehicles and machinery	30
Division L. Manufactures	17
Division M. Clocks, jewelry, etc	0
Division N. Painting, drawing, etc	407
Division O. Needlework, etc	437
Division P. Miscellaneous	107
Division R. Horticultural	782
Department of specials	164
Non-enumerated fruits	73
Total	4,910

PREMIUMS OFFERED AND AWARDED.

Cattle.

Class.		Offered.	Awarded.
1.	Shorthorns	$327 00	$252 00
2.	Devons	327 00	276 00
3.	Herefords	327 00	299 00
4.	Jerseys	327 00	327 00
5.	Galloways	327 00	291 00
6.	Aberdeen Angus	327 00	259 00
7.	Holstein Friesians	327 00	144 00
8.	Red Polled	327 00	311 00
9.	Fat cattle	159 00	134 00
10.	Dairy cows	15 00	15 00
	Total cattle	$2,790 00	$2,308 00

Horses.

Class.		Offered.	Awarded.
11.	Standard Bred Roadsters	$265 00	$227 00
12.	Roadsters not standard	153 00	53 00
13.	Carriage and buggy	175 00	142 00
14.	Saddle horse	40 00	24 00
15.	Horses of all work	268 00	138 00
16.	Cleveland bays	265 00	45 00
17.	French coach	265 00	0
18.	Hackneys	265 00	0
19.	Percheron or French Draft	265 00	37 00
20.	Clydesdale	265 00	85 00
21.	Grade Draft	156 00	83 00
22.	Shetland ponies	200 00	0
	Total horses	$2,582 00	$ 834 00
	Speed	3,300 00	3,300 00
	Grand total	$5,382 00	$4,134 00

Sheep.

Class.			Offered.		Awarded.
23.	American Merinos	Dip.	$194 00	Dip.	$194 00
24.	Rambouillet Merinos	"	146 00	"	146 00
25.	Delaine Merino, Dickinson or Blktp	"	146 00	"	138 00
26.	Merino ineligible to record	"	27 00	"	27 00
27.	Lincolns	"	134 00	"	134 00
28.	Leicesters	"	134 00	"	126 00
29.	Cotswolds	"	134 00	"	134 00
30.	Shropshires	"	146 00	"	146 00
31.	Hampshires	"	134 00	"	134 00
32.	Oxfords	"	134 00	"	122 00
33.	Southdowns	"	134 00	"	126 00
34.	Tunis		70 00		0
35.	Fat sheep		72 00		50 00
	Total sheep	10 Dip.	$1,605 00	8 Dip.	$1,477 00

Swine.

Class.			Offered.		Awarded.
36.	Berkshire	3 Dip.	$158 00	3 Dip.	$146 00
37.	Essex	3 "	158 00	3 "	137 00
38.	Suffolk or Small Yorkshire	3 "	158 00	3 "	154 00
39.	Poland China	3 "	158 00	3 "	158 00
40.	Duroc Jersey	3 "	158 00	3 "	95 00
41.	Chester White, Cheshires and Large Yorkshires	3 "	158 00	3 "	136 00
42.	Victoria	3 "	158 00	3 "	155 00
	Fat hogs		29 00		10 00
	Total swine	21 Dip.	$1,135 00	21 Dip.	$991 00

Poultry.

43.	Poultry		$677 00		$503 50

Division F.

44.	Grain and seeds		$137 50		$92 50
45.	Roots and vegetables		185 00		138 50
46.	Professional gardeners		90 00		90 00
47.	Flour, meal, etc		39 00		39 00
	Total		$451 50		$360 00

Division G.

49.	Butter, cheese, etc		$63 00		$38 00
50.	Sugar, bread and pickles		80 00		50 00
	Total		$143 00		$88 00

Division H.

52.	Bees and honey		$142 00		$136 00

Division J.

54.	Vehicles		14 Dip.		4 Dip.
			Silver cup and silver medal.		Silver medal.

Division L—Manufactures.

55.	Wool, etc		$38 00		$10 00
56.	Leather and rubber		121 00		00
57.	Furniture. Silver medal	Dip.	202 00		12 00
58.	Stoves, iron work, etc		35 00		0
	Total		$396 00		$22 00

Division M.

59.	Clocks and jewelry	9 Dip.	0		0

Division N.

60.	Painting, sculpture		$581 00		$482 00
61.	Painting and drawing by amateurs	1 Dip.	164 00	1 Dip.	107 00
62.	Industrial art	13 "	89 00	6 "	44 00
	Total	14 Dip.	$834 00	7 Dip.	$633 00

Division O—Needle Work and Fancy Work.

63.	Needle work		$28 00		$15 00
64.	Embroidery		152 50		121 00
65.	Crochet and knit work		60 50		26 00
66.	Children's		44 25		15 00
	Total		$282 25		$177 00

Division P.

67.	Miscellaneous		38 Dip.		3 Dip.
68.	Household articles		18 "		4 "
	Total		56 Dip.		7 Dip.

Division R—Fruits.

70. Artistic exhibits of horticultural products	$38 00	$38 00
71. General collection fruits for family use	60 00	60 00
72. General collection market fruits	44 00	34 00
73. Special exhibit peaches	36 00	22 00
74. Special exhibit pears	36 00	36 00
75. Special exhibit plums	17 50	9 50
76. Special exhibit grapes	33 50	30 00
77. Single plates of fruits	186 25	118 25
78. Preserved fruits and jellies	70 00	66 00

Flowers and Plants.

79. Flowers and plants in beds	$72 00	$72 00
80. Plants in pots	211 00	200 00
81. Cut flowers, boquets and floral designs	71 50	62 50
Total fruits, flowers and plants	$875 75	$748 25

Recapitulation.

Cattle	$2,790 00	$2,308 00
Horses	2,582 00	834 00
Sheep	1,605 00	1,477 00
Swine	1,135 00	991 00
Poultry	677 00	503 50
Grain, seeds, vegetables, flour and meal	451 50	360 00
Butter, cheese, sugar, bread, etc	143 00	88 00
Bees and honey	142 00	136 00
Wool, leather, rubber, furniture and iron work	396 00	22 00
Painting, drawing, etc	834 00	633 00
Needle work, knit work and crochet	285 25	177 00
Fruit, flowers and plants	875 75	748 25
Total regular	$11,916 50	$8,277 75
Speed	3,300 00	3,300 00
Special premiums		1,000 00
	$15,216 50	$12,577 75

Diplomas	43
Silver cup and silver medal	1 silver medal

Mr. Fifield, chairman of the Business Committee, presented the report of that committee covering the transactions for the year. Statement of Business Committee in detail:

Business Committee.

1897.		No. of order.			
Feb.	25	155	H. H. Hinds, personal expense	$36 85	
"	25	156	E. Fifield, personal expense	6 24	
"	25	17	E. Fifield, personal expense	6 99	
"	25	18	W. P. Custard, personal expense	4 38	
Sept.	11	60	W. P. Custard, personal expense	41 08	
"	11	61	E. Fifield, personal expense	81 46	
"	21	128	E. Fifield, personal expense	19 98	
"	21	130	W. P. Custard, personal expense	5 40	
					$193 38

Directors.

Feb.	25	15	M. P. Anderson, personal expense	$7 94	
Sept.	21	111	M. P. Anderson, personal expense	10 52	
"	21	55	I. H. Butterfield, personal expense	52 91	
Feb.	25	8	W. E. Boyden, personal expense	6 52	
Sept.	10	50	W. E. Boyden, personal expense	25 31	
Feb.	25	6	L. W. Barnes, personal expense	4 80	
Sept.	10	49	L. W. Barnes, personal expense	21 87	
"	9	67	Wm. Chamberlain, personal expense	7 76	
Feb.	25	7	H. D. Cutting, personal expense	7 65	
Sept.	10	40	H. D. Cutting, personal expense	26 00	
Feb.	25	9	H. R. Dewey, personal expense	75	
"	22	10	M. J. Gard, personal expense	7 01	
Sept.	10	42	M. J. Gard, personal expense	23 82	
Feb.	25	11	H. H. Hinds, personal expense	6 72	
Sept.	21	115	H. H. Hinds, personal expense	17 24	
Feb.	25	14	E. W. Hardy, personal expense	4 40	
Sept.	11	77	E. W. Hardy, personal expense	34 60	
"	10	38	N. J. Kelsey, personal expense	13 74	
Feb.	25	5	F. H. Latta, personal expense	4 05	
"	25	4	F. H. Latta, personal expense	15 40	
Sept.	21	112	F. H. Latta, personal expense	47 45	
Feb.	25	13	John Lessiter, personal expense	6 95	
Sept.	10	46	John Lessiter, personal expense	33 80	
Feb.	25	12	C. E. Lockwood, personal expense	8 28	
Sept.	9	68	C. E. Lockwood, personal expense	9 00	
"	11	69	C. E. Lockwood, personal expense	9 68	
"	10	48	Frank Maynard, personal expense	23 18	
"	10	44	F. L. Reed, personal expense	2 12	
"	10	45	F. L. Reed, personal expense	27 98	
Feb.	25	1	F. E. Skeels, personal expense	5 35	
Sept.	11	108	F. E. Skeels, personal expense	18 96	
"	11	63	L. G. Townsend, personal expense	28 50	
Feb.	25	3	A. H. Zenner, personal expense	7 51	
Sept.	11	72	A. H. Zenner, personal expense	16 18	
"	11	58	J. E. Rice (board Latta, Lockwood, Anderson)	34 50	
"	11	70	R. D. Graham, personal expense	10 30	
					$588 75

President's Office.

Feb.	25	157	Wm. Ball, personal expense	$11 73	
"	25	16	Wm. Ball, personal expense	5 40	
Sept.	10	103	Wm. Ball, personal expense	37 90	
"	11	102	Wm. Ball, personal expense	62 25	
"	11	101	L. W. Whitbeck, asst. pres. office	1 50	
"	10	39	G. L. Wight, asst. pres. office	5 00	
					$123 78

Secretary's Office.

Feb.	25	158	H. S. Fralick, personal expense and postage	$13 15	
"	25	2	H. S. Fralick, personal expense	8 90	
Mar.	1	21	H. S. Fralick, express on diplomas and post	10 00	
June	16	22	H. S. Fralick, postage	10 00	
July	14	23	H. S. Fralick, express on prem. lists	10 10	
"	14	24	H. S. Fralick, on salary	100 00	
"	14	25	H. S. Fralick, postage on prem. lists	70 00	
Aug.	12	28	H. S. Fralick, telegrams, freight, express, etc.	20 92	
Sept.	11	83	C. A. Mitts, telegrams	8 60	
"	20	120	H. S. Fralick, telegrams and express	39 10	
"	20	121	H. S. Fralick, postage	41 25	
"	21	125	Pay roll secretary's office	160 93	
"	21	127	On salary (balance)	400 00	
"	21	131	Personal expense	15 50	
"	28	133	Telegraph, telephone, etc.	2 99	
					$911 44

Treasurer's Office.

Feb.	26	19	C. W. Young, personal expense	$10 80	
"	26	20	C. W. Young, personal expense	13 05	
Sept.	11	104	J. E. Rice, board Young and Parks	33 00	
"	21	129	C. W. Young, pay-roll	117 19	
"	21	132	C. W. Young, salary and personal expense	233 55	
Oct.	2	135	I. R. Church (safe Treas. office)	3 00	
					$410 59

Judges.

Sept.	9	33	Prof. L. R. Taft, horticultural department	$11 00	
"	10	35	G. Butterfield, swine and poultry department	35 00	
"	10	37	S. L. Wise, art department	29 66	
"	10	47	G. H. Seeley, horse department	23 95	
"	10	51	George Streart, sheep department	16 13	
"	11	70	M. L. Dean, horticulture department	11 00	
"	11	70	M. Curskurski, horticulture department	5 00	
"	10	50	F. Johnson, cattle department	31 50	
"	11	68	Mr. Taft, sheep department	15 00	
"	10	42	Mr. Bates, dairy department	4 00	
"	10	45	H. Strong, agriculture department	3 00	
"	11	107	Mrs. R. E. Watson, needlework department	4 00	
					$189 24

Printing and Stationery.

Sept.	1	64	C. & J. Gregory Co., printing tickets	$23 50	
"	11	75	Stanton Ptg. Co., printing	168 40	
"	11	98	Fair Publishing House, printing tickets	37 50	
"	11	100	Will M. Hine, stationery	5 70	
					$235 10

Music.

Sept.	20	109	Frank Wurzburg, band	$204 00	
					$204 00

Badges.

Aug.	26	89	The Whitehead & Hoag Co	$8 75	
Sept.	11	96	Spring & Co., ribbons and badges	23 85	
					$32 60

Advertising.

July	20	26	C. B. Crisp, sign on building	$20 00	
"	10	41	H. D. Cutting, posting bills	10 00	
"	11	52	Sanders Publishing Co., adv. Breeders Gazette	18 90	
"	11	53	The Workman, adv	15 00	
"	10	54	O. J. Mulford, adv. street cars	20 00	
Sept.	10	59	Evening Press, adv	50 00	
"	9	62	C. J. Bloomfield, bill posting	9 95	
"	11	76	Stanton Ptg. Co., ad. in Labor Day program	20 00	
Aug.	27	78	Geo. M. Savage, ad. in 120 papers	120 00	
Sept.	11	80	The Democrat, adv	50 00	
"	11	86	H. S. Fralick, pd. bills for posting	127 75	
"	11	87	Clark Potter, bill posting	75 00	
"	7	88	Geo. M. Leonard, bill posting	211 60	
Aug.	29	90	A. Gast, Litho. Co	81 00	
Sept.	11	91	H. S. Fralick, ads. in newspaper	50 40	
"	8	110	Grand Rapids Herald, adv	50 00	
"	21	113	H. S. Fralick, ads. in newspapers	93 15	
"	21	114	H. S. Fralick, pd. bill posters	49 27	
"	21	118	H. S. Fralick, ad in Horse Review	5 00	
"	20	122	H. S. Fralick, bill posting railroads	36 71	
"	11	75	Stanton Ptg. Co., ad. posters	148 00	
"	11	98	Fair Publishing House, posters	20 00	
"	28	134	H. S. Fralick, ad. in newspapers	45 90	
					$1,327 63

Gate Department.

Sept.	11	85	W. P. Custard, pay roll	$170 76	
					$170 76

Police Department.

Sept.	11	82	E. W. Hardy, pay roll	$508 41	
					$508 41

Booths and Privileges.

Sept.	11	107	F. E. Skeels, pay roll, ticket takers	$52 83	
					$52 83

Buildings and Grounds.

Sept.	8	74	J. Dupree & Co., lumber	$11 60	
"	3	79	C. A. Coye, tents for exhibits	130 25	
Aug.	31	84	D. Skeels, surveying	20 00	
Sept.	11	93	Fuller & Rice Lumber Co., lumber	10 50	
"	11	94	Peter Brown, care of grounds	50 00	
"	11	95	F Letellier & Co. Lumber	7 88	
"	11	99	Dolan & Muir, plumbing	12 00	
"	11	105	D. W. Packard, use of tents	25 00	
"	11	107	F. E. Skeels, carpenters and ice	67 50	
"	21	117	Peter Brown, cleaning grounds	20 00	
"	21	119	H. S. Fralick, pay roll for help	69 80	
"	21	124	H. D. Plumb, supplies	10 57	
"	11	92	Foster, Stevens & Co., hardware	11 04	
					$446 14

Speed Department.

July	22	27	Membership Am. Trotting Association	$50 00	
Sept.	11	56	Geo. S. Ward, clerk	54 96	
"	7	31	C. W. Young, to pay purses	870 00	
"	8	32	C. W. Young, to pay purses	900 00	
"	9	34	C. W. Young, to pay purses	900 00	
"	10	43	C. W. Young, to pay purses	600 00	
"	11	57	E. Fifield, horse Woodlawn	100 00	
"	11	65	E. Fifield, for judges	74 43	
"	11	66	Dr. J. W. Furguson, Bicycle Johnnie	400 00	
"	11	106	P. Tierny, for getting entries	20 00	
"	21	123	C. A. Van Slyck, flagman	5 00	
					$3,974 39

General Expense.

Feb.	25	159	Calvert Litho. Co., Detroit, diplomas	$7 50	
Sept.	7	29	Trades and Labor Council, percentage of receipts	440 57	
"	7	30	Modern Woodman, per cent of receipts	300 00	
"	10	36	L. S. Moores, assistant art department	12 61	
"	11	73	H. S. Fralick, mailing tubes	6 80	
"	11	71	Chas. Bowditch, asst. hort.	10 50	
"	10	40	Mr. Ball, assistant poultry department	1 50	
"	10	45	D. A. McCormick, assistant agricultural hall	10 00	
"	9	81	H. Leonard Sons & Co., vases broken	6 75	
"	11	96	Spring & Co., decorating	122 14	
"	11	97	Old National Bank (note)	505 15	
"	21	116	H. S. Fralick, sundry bills	12 96	
"	21	126	Security Co. storing and moving goods	9 00	
Oct.	9	136	Premiums paid	8,251 50	
Dec.	7	137	H. S. Fralick, sundry bills	7 35	
					$9,704 33

Summary.

Business committee	$193 38	
Directors	588 75	
President's office	123 78	
Secretary's office	911 44	
Treasurer's office	410 59	
Judges	189 24	
Printing and stationery	235 10	
Music	204 00	
Badges	32 60	
Advertising department	1,327 63	
Gates department	170 76	
Police department	508 41	
Booths and privileges	52 83	
Buildings and grounds	446 14	
Speed department	3,974 39	
General expenses	9,704 33	
		$19,073 37

The treasurer presented his report as follows:

To the President and Members of the Executive Committee of Michigan State Agricultural Society:

Gentlemen—I hereby submit the following as my report as treasurer for the year 1897:

RECEIPTS.

Cash on hand at beginning of year		$187 12
Received from general admission		8,538 10
Received from grand stand		1,296 50
Received from speed department		2,035 00
Received from American Trotting Association		38 00
Received from railroad coupon tickets		3,619 50
Received from privileges		2,318 19
Received from secretary's office		682 00
Received from membership treasurer's office		186 00
Received from note at bank		500 00
Total		$19,400 41
Expenditures paid on business orders	10,927 97	
Expenditures paid on premiums	8,261 50	
Amount of cash on hand	210 94	
Total	$19,400 41	

Respectfully submitted,

C. W. YOUNG,
Treasurer.

January 11, 1898.

On motion the reports of the Secretary, the Business Committee and the Treasurer were accepted and referred to the Finance Committee.

Mr. Anderson of the Finance Committee being absent, the president appointed I. H. Butterfield to act in his place.

The reports of executive superintendents were presented.

REPORTS OF SUPERINTENDENTS.

REPORT OF SUPERINTENDENT OF CATTLE.

To the President and members of the Executive Committee, Michigan State Agricultural Society:

Gentlemen—Your Superintendent of Cattle would report as follows:

Whole number of entries	314
Amount of premiums offered	2,790 00
Amount of premiums awarded	2,318 00

Entries were divided as follows:

Division A—Cattle.

		Entries.	Amt. Offered.	Amt. Won.
1	Shorthorns	33	$327 00	$252 00
2	Devons	33	327 00	276 00
3	Herefords	31	327 00	299 00
4	Jerseys	72	327 00	327 00
5	Galloways	32	327 00	291 00
6	Aberdeen Angus	28	327 00	259 00
7	Holstein Friesians	18	327 00	144 00
8	Red polled	43	327 00	321 00
9	Fat cattle	18	159 00	134 00
10	Sweepstakes for dairy cows	6	15 00	15 00
	Totals	314	$2,790 00	$2,318 00

The exhibition as a whole in this department was a very creditable one, the best we have had in several years, and, so far as I am able to learn, was as free from any unpleasant features as one could expect. I have no recommendations to offer. While the expenses of this department are somewhat more than I wish they were, I was unable to procure a competent judge at less compensation, and feel that his pay was money well spent. All of which is respectfully submitted.

W. E. BOYDEN,
Superintendent Cattle.

REPORT OF SUPERINTENDENT OF HORSES.

To the President and Executive Committee of the State Agricultural Society:

The entries in this division were as follows:

Division B—Horses.

	No. of Entries.	Amt. Offered.	Amt. Won.
Standard Bred roadsters	59	$265 00	$227 00
Roadsters not standard bred	21	153 00	53 00
Carriage and buggy horses	20	175 00	142 00
Saddle horses	4	40 00	24 00
Horses of all work	22	268 00	138 00
Cleveland Bays	5	265 00	45 00
French coach horses	1	265 00	......
Hackneys	1	267 00	......
Percheron or French draft	3	265 00	37 00
Clydesdale or English shire	8	265 00	85 00
Grade draft	12	156 00	83 00
Shetland ponies	..	200 00	......
Totals	156	$2,584 00	$834 00

The entries in this department were small to what they formerly were, but some credit is due to Mr. Morse of Grand Rapids, who showed some good horses and decorated his stalls with taste. I would not make any recommendation, believing the lack of interest in this department is owing to the depreciation in the value of horses. All of which is respectfully submittted.

JOHN LESSITER,
Superintendent of Division B.

REPORT OF SUPERINTENDENT OF SPEED.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—I submit my report for Speed Department:

Total amount of premiums offered		$3,300 00
Total amount of premiums paid		3,165 00
Received from entrance money	$1,930 00	
Unclaimed premiums	105 00	
On suspension from Steiner	38 00	
Total	$2,073 00	$2,073 00
Cost of races		$1,227 00
Paid "Bicycle Johnny"		400 00
Paid Woodlawn saddle horse		100 00
Total		$1,727 00
Received from grand stand receipts	$1,296 50	
Received from pools	317 00	
Received from wheels	500 00	
Total	$2,113 50	
Less Races and attractions	1,727 00	
Leaving credit balance	$386 50	

EUGENE FIFIELD,
Superintendent Speed Department.

REPORT OF SUPERINTENDENT OF SHEEP.

Division C—Sheep.

	No. of Entries.	Amt. Offered.	Amt. Won.
Thoroughbred American Merinos	113	$194 00	$194 00
Rambouillet Merinos	31	146 00	146 00
Delaine Mer. Dickinson or Blktp.	38	146 00	138 00
Merinos ineligible to record	19	27 00	27 00
Lincolns	37	134 00	134 00
Leicesters	35	134 00	126 00
Cotswolds	37	134 00	134 00
Shropshires	62	146 00	146 00
Hampshires	44	134 00	134 00
Oxfords	20	134 00	122 00
Southdowns	38	134 00	126 00
Tunis		70 00	
Fat	13	72 00	46 00
Totals	487	$6,605 00	$1,473 00

Specials—Division C Continued:

Cotswolds	8	$30 00	$30 00
Shropshires	8	35 00	35 00
Hampshires	3	25 00	25 00
Oxford downs	1	50 00	10 00
Totals	20	$140 00	$100 00

REPORT OF SUPERINTENDENT OF POULTRY.

To the President and Executive Committee of the Michigan State Agricultural Society:

As Superintendent of Division F, Poultry, I beg leave to report the number of entries and the amount of awards as follows:

Division E—Poultry.

	No. of Entries.	Amt. Offered.	Amt. Won.
Asiatic class	98	$48 00	$42 00
American class	125	84 00	58 00
Bantams other than game	96	78 00	54 00
English class	28	18 00	14 00
French class	12	18 00	11 00
Game and game bantam class	119	108 00	71 00
Mediterranean class	129	72 00	64 00
Hamburg class	34	36 00	28 00
Red Capes	6	12 00	5 00
Polish class	49	48 00	38 00
Miscellaneous	13	36 00	16 00
Turkey class	14	27 00	16 50
Duck class	56	34 00	34 00
Goose class	33	36 00	36 00
Ornamental class	14	12 00	11 00
Pigeon class	5	3 00	3 00
Totals	831	$670 00	$501 50

H. D. CUTTING,
Superintendent.

REPORT OF SUPERINTENDENT OF FARM PRODUCTS.

Division F—Farm and Garden Produce.

	No. of Entries.	Amt. Offered.	Amt. Won.
Grains and seeds	68	$41 50	$34 50
Corn	64	84 00	58 00
Roots and vegetables grown by exhibitor	250	185 00	138 50
Roots and vegetables by gardener	6	90 00	90 00
Flour, meal and feed	20	39 00	39 00
Totals	408	$439 50	$360 00

The exhibition in Division F, Farm and Garden Produce and Manufactured Products, at the last fair, was equal and in some respects better than in past years. The Canadian exhibit of grains, grasses and minerals made by their Chief Agent, Mr. McInnis, for the United States, added very much to the interest in Agricultural Hall, and many were the inquiries in regard to the great Northwest, which the agent was able to answer in good shape. Some of his goods came too late to be placed on exhibition.

F. L. REED,
Superintendent.

REPORT OF SUPERINTENDENT OF DAIRY, BEES AND HONEY.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—I would report that Division G, Class 49, Butter, Cheese and Dairy Articles, were with the exception of cheese, well represented. There were about the usual number of cheeses, as for the last two fairs. In my opinion, it is a very meager exhibit to represent the great interest of the cheese manufactured in Michigan. I asked one of the exhibitors why there was not more interest taken by the manufacturers to make a more creditable display. He gave as his opinion, that our rules requiring the make of three different months was the reason. But few manufacturers keep cheese on hand for so long a time. When our fairs are held in the first half of September, it would require cheese made in June to supply a part of the exhibit. I would recommend that the rule be changed or amended so as to read as follows: Display of cheese by any factory, quality considered, not less than six cheeses, and representing the make of any month not later than the month preceding the month in which the fair is held, and may be represented by twins of ordinary size.

There was a very nice exhibit of butter, both creamery and domestic manufacture, and of excellent quality.

There were 23 entries of butter and cheese.

In Class 50, Sugar, Bread and Pickles, there were 53 entries containing a large number of samples of bread, consisting of all the known kinds, except the bad. The two large show cases were crowded full and piled on. The competition was sharp. The awarding committee was put to a severe test to decide, in many instances. It seems to me that properly arranged score cards would assist the committees very much in awarding premiums on bread and would be more likely to arrive at just conclusions. I would recommend that Division G, Class 50, be amended so as to read, Sugar, Bread, Pickles and Canned Vegetables.

Lot 18 should be amended to correspond.

Dairy implements and machinery were well represented by a number of exhibitors. The display was large, consisting of all the implements and machinery used in the dairy business. The space for exhibition was too limited for convenient and interesting display. There was some complaint, but no ill feeling manifested.

The refrigerator will need some repairs, as it leaked quite badly, water running through the wall, wetting the floor of the office of Superintendent of the Horse Department.

The total amount of money offered in Division G, was	$143 00
Amount awarded	113 00
The expenses of the Dairy Department authorized by me was	12 00
(Exclusive of my individual expenses) to wit:	
Northern Ice Company, 3,400 pounds ice	8 00
E. N. Bates, Judge, butter and cheese, one day and expenses	4 00
Total	$12 00

Division H, Bees and Honey, as is usual, proved to be the most attractive feature of the exhibition. Although the exhibit was not nearly so large as at the previous fair, it was probably as useful in the way of an object lesson, and attractiveness, as any previous exhibits. All the different races of bees were exhibited. Mr. W. Z. Hutchinson and brother were the main exhibitors.

Mr. H. D. Cutting did the judging and made no charge for his services.

Amount of money offered for premiums	$142 00
Amount of money awarded	113 00

All of which is respectfully submitted.

M. J. GARD,
Superintendent.

REPORT OF SUPERINTENDENT OF MANUFACTURES.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Through the kindness of your secretary, I am able to make the following detailed statement of the department allotted to me:

Division L and M—Manufactured Goods, Musical Instruments, etc.

	No. of Entries.	Amt. Offered.	Amt. Won.
Materials, wool	8	$38 00	$10 00
Articles of leather and India rubber	0	121 00	
Articles of furniture	9	202 00	12 00
Stoves, iron work and ornamental concrete work	0	35 00	
Musical instruments, sewing machines, etc	0		
Clocks, jewelry, plated ware	0	9 Diplomas	
Total	17	$396 00	$22 00

Division N—Painting, Sculpture, etc.

Painting by professionals or amateurs	97	$272 00	$272 00
Frames	3	16 00	13 00
Statuary	0	63 00	
Photographs	19	30 00	24 00
Painting by professional artists and art teachers	111	200 00	179 00
Total	230	$581 00	$488 00

PAINTING AND DRAWING BY AMATEUR ARTISTS.

Painting	61	$122 00	$71 00
Drawing	56	42 00	35 00
Industrial art	60	89 00	31 00
Total	177	$253 00	$137 00

RECAPITULATION.

Number of entries, all departments	424
Amount offered	$1,230 00
Amount awarded	647 00
Total	$1,877 00

Owing to sickness, I was unable to be present at the last annual meeting, and I want to thank the gentlemen who so kindly carried out the work for me. I spent one day previous to the opening of the fair and made partial arrangements and am informed that all was carried out and that good feeling prevailed and that all was harmonious. Last year I recommended a complete revision of Division N, and was instructed by the committee to have it done, but owing to the long delay in deciding the holding of the exhibition, the work was not accomplished. I renew my recommendation again, for the same reasons as given last year, viz.: That the list, as now printed, is not up to late art work, and it costs the society more to carry on this list than it would were it modernized and made to fit present progressive conditions of the profession. I have no other recommendations to offer.

Respectfully submitted.

M. P. ANDERSON,

Superintendent.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Having been during the last State Fair, assigned to the above department, owing to the illness of its superintendent, I have to say that I most heartily endorse the recommendations contained in his report. I would also add that Prof. Wise, who was in charge of Division N, is entitled to credit for the admirable arrangement of exhibits in that division and for the harmony which seemed to prevail there. The greater portion of exhibits in Division L and M were not entered for premiums, but simply for exhibition. Notably so were the exhibits from the city of Grand Rapids. To mention any one of the latter in point of preference would seem to me unjust, as they were all of a high order, reflecting credit not only to the exhibitor and the city of Grand Rapids, but to the fair and State at large.

But for the assistance of the President and Secretary of this Society, and whom I desire to thank, my duties in connection with this department, which were entirely new to me, would have been extremely embarrassing.

In conclusion, I would suggest that the diplomas offered and allowed in this department be placed at as early a date as possible.

Respectfully submitted,
NEWELL J. KELSEY,
Acting Superintendent.

REPORT OF SUPERINTENDENT OF FARM IMPLEMENTS AND VEHICLES.

To the President and officers of the Michigan State Agricultural Society:

Gentlemen—Owing to the fact that all of the jobbers of implements in Grand Rapids, with one exception, refused to make any display at our last fair, it was made necessary to do much hard work to secure a good exhibit. However, the matter summed up is, that we had a good exhibit, I think fully equal to either year that immediately preceded it, and was a source of much satisfaction under the circumstances both to exhibitor and your superintendent.

Divison J.—Vehicles.

We had 43 entries—a fairly good exhibit, not as good as might have been secured by earlier work. The room for this department is close—not what it should be on the present grounds. I would recommend some change if possible, to give more room, and nearer the implement department. It would give much better satisfaction and allow the exhibit in many cases of the two departments by one firm.

With the assurance I have, I can promise a fine exhibit of both departments for a coming fair.

F. H. LATTA.
Superintendent of Implements.

REPORT OF SUPERINTENDENT OF NEEDLEWORK.

To the members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As Superintendent of the Needlework Department of our fair of 1897, I submit the following report: There were 437 entries in this exhibit, 34 of which were in plain needlework, 253 in embroidery, 100 in crochet and knit work and 43 in children's class.

The offerings in plain needlework were $28.00, of which $15.00 were taken; $152.50 were offered in embroidery, $121.00 being taken. Of the $60.50 offered for crochet and knit work, $26.00 were awarded, while of the $44.25 offered in children's department, only $15.00 were taken. The total offering of this division was $285.25, of which $177.00 or about 62 per cent of the offering, was taken. Owing to press of other business connected with the fair, I deemed it best to appoint Mrs. F. E. Skeels Acting Superintendent of this department, and the success attained there is due to her management rather than to any effort of mine. So far as I have been informed, no fault was or has been registered against this division. The premium list was thoroughly revised and the result was very evident in the change made in the exhibit. It is suggested to us by Mrs. Skeels that another revision of this department would result in a much more attractive display, and she would earnestly recommend a division of the department into professional and amateur classes, thus drawing exhibits from a much larger field than now. It is possible to do this without raising the offering in this department although it would seem that as we have less than $300 in premiums while we offer $834.00 in the arts, we could stand a little raise in the premiums offered in the needlework division.

Sincerely,
F. E. SKEELS,
Superintendent.

REPORT OF SUPT. OF HORTICULTURAL PRODUCTS.

To the officers and directors of the Michigan State Agricultural Society:

Gentlemen—Your Superintendent of the Department of Fruits and Flowers reports as follows: As you are aware, the year of 1897 was not a fruit season so far as large or tree fruits were concerned, and the outlook for a creditable display was anything but bright and for this reason I did not make the usual trip through the various fruit growing counties, thereby saving a considerable sum of money, but confined my soliciting to correspondence, which, however, was productive of but meagre results. At the opening of the fair, however, by personal solicitation among the fruit growers in the vicinity of Grand Rapids, we finally succeeded in obtaining a very presentable display—of course, nothing to compare with that of the preceding year, but considering that it was largely picked up after the opening of the fair and the condition of the crop in general, it did very well. Notwithstanding the rules of the society, I was obliged to accept entries on the second day, or have a hall full of empty benches, both in the fruit and flower exhibits, in the fruit department in order to get it at all and the exhibitors of flowers, all were of the opinion that to place the exhibits of many kinds earlier would not only destroy the specimens, but detract materially from the show. The exhibit of flowers was very large and fine and attracted much attention and many favorable comments. In this connection, I desire to recommend that premiums for plants and flowers shown in beds be discontinued. With our facilities for showing, they are not an attractive feature of the display, and the same money put into other premiums would make a far greater show.

Following is a list of entries:

Division R.—Horticultural.

	No. of entries.	Amt offered.	Amt won.
Artistic exhibits of horticultural products	5	$38 00	$38 00
General collection of fruits for family use	6	60 00	60 00
General collection market fruits	5	44 00	34 00
Special exhibit, peaches	3	36 00	22 00
Special exhibit, pears	15	36 00	36 00
Special exhibit, plums	9	17 50	9 50
Special exhibit, grapes	25	33 50	30 00
Single plates of fruit—Apples	202	186 25	118 25
Pears	128		
Peaches	53		
Plums	80		
Grapes	83		
Quinces	8		
Dried, canned and preserved fruits and jellies	20	70 00	66 00
Plants and flowers shown in beds	10	72 00	72 00
Plants in pots	88	211 00	200 00
Cut flowers, boquets and floral designs	42	71 50	62 50
Total	782	$875 75	$748 25

R. D. GRAHAM,
Superintendent.

REPORT OF SUPERINTENDENT OF MISCELLANEOUS EXHIBITS.

To the President and Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As Superintendent of Division P, I beg leave to report: The whole number of entries was 107. Class 67 had 97 entries, 3 diplomas awarded. Class 68 had 10 entries, 4 diplomas awarded. Class 69, no entries. The exhibit was good in this department. Think the diplomas in this department give much better satisfaction to exhibitors than a cash award.

FRANK MAYNARD,
Superintendent.

In Division K, the entries were turned over to Mr. F. H. Latta and taken care of in the Implement Department.

In the Department of Specials, the whole number of entries was 164. Owing to the nature of the awards in this department, they being offered by outside parties, I am unable to state the whole number of awards. This department furnished quite an interesting and attractive feature of the fair.

FRANK MAYNARD,
Superintendent.

REPORT OF SUPERINTENDENT OF FORAGE.

To the President and members of the Executive Committee:

Gentlemen—As Superintendent of Forage, I beg leave to report as follows:

Total cost	$142 36
Number of tons of straw used	26 365

Through the kind assistance of superintendents in various live stock departments, think the cost of the department was reduced very materially. I would suggest that exhibitors be furnished stalls free, and they then furnish themselves with straw. All of which is respectfully submitted.

W. E. BOYDEN,
Superintendent of Forage.

POLICE DEPARTMENT.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—By the advice of Secretary Fralick and members of the Business Committee, we had two men on the grounds as early as Thursday preceding the fair, and as necessity required, our number increased to 40 men on the pay roll for the day and night force on Thursday of the fair.

Pay roll of police department—total	$798 41
Total amount collected on fines	2 55

I wish to express my thanks to the president and other members of the board for their personal aid and advice and especially to Chief of Police Cass of Grand Rapids, and Sheriff Woodworth, for the active part they took in keeping the grounds clear of crooks. They or their men were constantly on the ground to aid in keeping order, and that without expense to the society. In my judgment, the fact of their being there and ever on the alert had very much to do with having this department run so smoothly.

Respectfully submitted,
E. W. HARDY,
Superintendent.

REPORT OF SUPERINTENDENT OF GATES.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As Superintendent of Gates, I make the following report: I employed eleven men to tend the gates, and four men to tend grand stand doors, making fifteen men in all, at a cost of $170.76. Owing to the first day of the fair being Labor Day and the Woodmen's celebration on the fair grounds, I was obliged to have full force of men at the gates Monday morning, and to keep them till the close of the fair, that making the expense more than it would have been if we had had no extra celebration the first part of the week. If the State Fair is held in Grand Rapids in 1898, I would recommend that the treasurer have a ticket seller located between the river bridge and south gate, to sell tickets to those that are in carriages and want to drive on the grounds and not allow the ticket taker to handle any of the money.

Respectfully submitted,
W. P. CUSTARD,
Superintendent of Gates.

The reports were referred to the Committee on Premium List and Rules.

A petition was received from several breeders of sheep, asking for a separate class for imported sheep. Referred to the Committee on Premium List.

The president appointed Committee on Premium List as follows: Mr. Eugene Fifield, Chairman; H. R. Dewey, R. D. Graham, L. W. Barnes, John Lessiter, E. W. Hardy, F. E. Skeels.

A recess was then taken to 9 o'clock a. m., January 11th.

January 11th, 9 o'clock a. m. Committee met, all members present except Mr. Anderson.

A committee from the citizens of Grand Rapids appeared in reference to next fair, and stated that Grand Rapids would make the usual provision of guarantee for expenses and assist in securing satisfactory rates from the railroads.

Mr. Barnes and Mr. Smith of Muskegon Agricultural Socitey appeared in the matter of dates of fair, wishing to avoid a collision of dates with the State Fair.

The Committee on Sub-division of Subjects in president's address reported as follows:

Your committee to whom was referred the president's address recommend that so much as relates to a reduction of the premium list be referred to the Premium List Committee; that so much as refers to securing rates on railroads be referred to a special committee of three; that so much as refers to date of holding a fair be referred to a special committee of three; and that the whole question of holding a fair be referred to the Executive Committee.

The report was accepted and adopted.

The president appointed as committee to confer with the railroads: Fifield, Young, Butterfield; as committee on time of holding the fair· Graham, Gard, Boyden.

The Finance Committee reported as follows:

Your Committee on Finance, to whom was referred the reports of the secretary and the Business Committee, would report: That they have checked the vouchers with orders drawn, counted the stubs of membership tickets sold, made footings of the amounts of vouchers and orders drawn on treasurer, and find the reports correct, and the total of orders drawn $19,073.37.

Respectfully submitted,

I. H. BUTTERFIELD,
C. E. LOCKWOOD,
H. R. DEWEY,
Committee.

The report was accepted and adopted.

Also your committee would report that they have examined the report of the treasurer, have checked the orders paid, compared the several items of receipts with the reports of the secretary and superintendents of the privileges and speed departments; made the footings, and find the report correct, and the balance in the hands of the treasurer at this date, $210.94.

Respectfully submitted,
I. H. BUTTERFIELD,
C. E. LOCKWOOD,
H. R. DEWEY,
Committee.

The report was accepted and adopted.

A recess was taken to 1:30 p. m.

Committee met at 1:30 p. m.

The committee on premium list reported substantially the list of 1897, with revisions in the art and needlework departments. On a motion to adopt it was moved to amend by reducing all premiums on live stock $1.00 on each premium. Amendment carried and the report and list as amended adopted. See premium list for 1898.

On motion the salary of the secretary was fixed at $575.00, he to pay all clerk hire. The salary of the treasurer was fixed at $200.00.

The bond of the treasurer was fixed at $20,000, and the bond of the secretary at $1,000.

The business committee was authorized to sell admission tickets in blocks of five for $1.50.

The committee proceeded to the election of a general superintendent. The secretary was instructed to cast the ballot of the committee for Eugene Fifield. On motion W. P. Custard was elected member of the business committee. Mr. Fifield declined to act.

A recess was taken to 9 o'clock a. m., January 12th.

Nine o'clock a. m., January 12th.

Committee met. Called to order by the president. Mr. Custard asked to be excused from service on the business committee.

On motion a ballot was then taken for general superintendent and Mr. Fifield had 16 votes and Mr. Dewey 1 vote. Mr. Fifield was declared elected.

A ballot was taken for member of the business committee and I. H. Butterfield received 17 votes and was declared elected.

On motion of Mr. Latta the date and location of the fair was left with the business committee, president and treasurer.

The committee to confer with the railroad authorities reported that they had performed that duty and had received promise of hearty cooperation in special rates for the fair.

The business committee was instructed to procure a silver cup for award on exhibition of Vehicles.

On motion a vote of thanks was given Mr. L. J. Rindge and Mr. Z. E. Cheney for assistance rendered during the year.

The president appointed standing committees and executive superintendents as follows:

Business committee (elected), Eugene Fifield, I. H. Butterfield and the secretary.

Transportation and program committee.

Same as business committee.

Reception committee—Wm. Chamberlain, A. O. Hyde.

Finance committee—M. P. Anderson, H. R. Dewey, C. E. Lockwood.

Premium list committee—Eugene Fifield, H. R. Dewey, R. D. Graham, L. W. Barnes, John Lessiter, E. W. Hardy, F. E. Skeels.

Committee on rules—I. H. Butterfield, W. P. Custard, F. H. Latta.

General Superintendent—Eugene Fifield.

Chief Marshal—L. G. Townsend.

EXECUTIVE SUPERINTENDENTS.

Cattle—W. E. Boyden.
Horses, speed—Eugene Fifield.
Horses, Roadsters, Draft and Pony Classes—H. H. Hinds.
Sheep—John Lessiter.
Swine—L. W. Barnes.
Poultry—H. D. Cutting.
Dairy, Bees and Honey—M. J. Gard.
Farm and Garden Products— F. L. Reed.
Vehicles—H. R. Dewey.
Machinery—Frank Maynard.
Manufactured Goods.—M. P. Anderson.
Art Hall—N. J. Kelsey.
Needle Work and Children's Work—Mrs. F. E. Skeels.
Miscellaneous and Special Exhibits, Except Specials on Fruits—Frank Maynard.
Horticulture—R. D. Graham.
Gates—W. P. Custard.
Police—E. W. Hardy.
Forage—C. E. Lockwood.
Agricultural Implements—F. H. Latta.
Booths and Privileges—F. E. Skeels.

On motion adjourned to the call of the president.

H. S. FRALICK,
Secretary.

REPORT OF THE GOGEBIC COUNTY AGRICULTURAL SOCIETY FOR 1897.

Ironwood, Mich., Dec. 20, 1897.

Secretary of State Agricultural Society,
Lansing, Mich.:

Sir—The undersigned, officers of the Gogebic County Agricultural Society, submit the following report of the transactions of the said society during the past year of 1897:

The first annual fair and exhibition of the society was held this year on September 9th, 10th and 11th, at the City Park in this city, and proved a great success. It was not thought possible until about a month before the date of the fair, that one could be given successfully this year, but it was then determined to hold one and every effort was exerted to make it a success and although the time was short in which to prepare for it, it was successful far beyond the expectations of the society. The Ladies' Auxiliary, organized in connection with the society, rendered great assistance. All those who participated in the exhibits this year have promised to make more thorough preparation for the fair another year and the one which will be given during the summer of 1898 should, and undoubtedly will, prove a decided improvement on the one given this year. Among the improvements on the grounds of the society made during the past year is a row of substantial sheds for the exhibition of stock. The financial aid given by the Board of Supervisors of Gogebic county, was continued during the past year and the percentage of taxation for this purpose raised from 1-20 to 1-10 of a mill. The board has also voted another tax of 1-10 of a mill for the coming year. The finances of the society are in excellent shape. The financial report of the secretary and treasurer and the list of premiums given is attached hereto.

(Signed.)
WALTER S. GOODLAND,
President.
C. E. HOUK,
Secretary.
JOHN MULLEN,
Treasurer.

FINANCIAL REPORT.

RECEIPTS.

The following are the receipts and disbursements of the society for the past year:

April 14, 1896, from John Evans, city treasurer	$274 38
June 8, 1896, from C. E. Houk, secretary	70 00
June 15, 1896, from John Evans, city treasurer	15 29
July 20, 1896, from City Ironwood	300 00
April 14, 1896, from John Evans, city treasurer	$274 38
August 20, 1896, from John Evans, city treasurer	32 62
September 13, 1897, receipts from county fair	355 25
Total	$1,727 54

DISBURSMENTS.

Last report	$1,697 31
People Banking Co., interest on note	33 83
Hager Lumber Co., lumber	22 16
J. R. Moore, sundries	3 10
A. D. Garner, insurance on building	25 00
Chas. Garland, distributing bills, etc.	15 00
F. A. Healey, for selling tickets	11 50
Sam Scott and others, labor on grounds	57 64
F. M. Prescott and others, merchandise	40 74
Purses for race meeting	162 00
Band	40 00
John Morrison, livery	9 70
Peaslee & Douglass, printing	37 05
Bennett & Green, printing	25 00
Officers' expenses for two years	40 00
Total	$2,220 03
Premiums paid county fair	129 75
Total disbursements	$2,349 78
Receipts	1,727 54
Indebtedness	$622 24

We will have about $900 coming from the county from this year's tax, which will more than pay off our indebtedness and leave about $300 in the treasury.

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